ELECTRICAL WORLD

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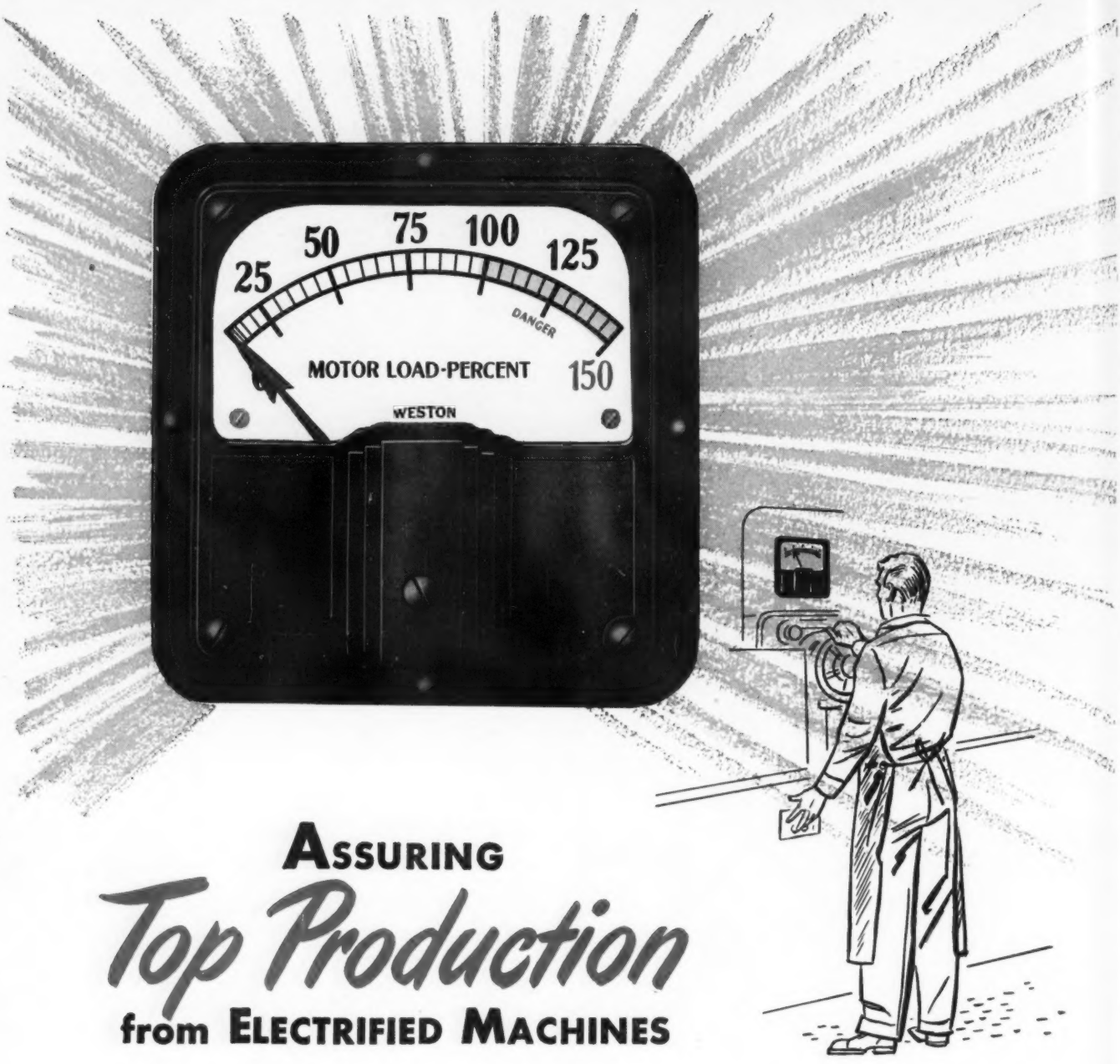
JUNE 19, 1948

Fire Extinguishing System Uses Emulsion-Forming Spray



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OVERLOAD . . . *permits corrections before serious troubles occur.*

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ELECTRICAL WORLD

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June 19, 1948

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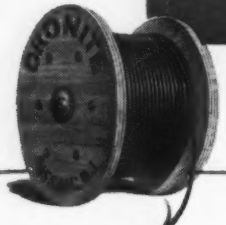
COMING IN THE JULY 3 ISSUE
5th Steam Station Cost Survey

VULCANIZING IN A METAL MOLD GIVES *Longest-Lived* CABLES

...but only Okonite uses this process as standard practice



with today's installation costs* only the *Longest-Lived* will be economical

* The lifetime cost of a cable rather than its first cost is the only true measure. Okonite wires and cables, built to stand up better and longer, can offset high installation costs.

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When Okonite insulated wires and cables are vulcanized, every foot that enters the huge pressure chamber receives uniform treatment. One reason is this:– on the reel or drum as it goes into the vulcanizer, the complete length of cable is compressed within a *continuous metal mold.* And this metal mold insures equal transfer of the heat throughout every portion of the insulation.

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Bulletin EW-101 describes and shows this operation and others – all based on Okonite's years of experience in making the longest-lived cable money can buy. Write to The Okonite Company, Passaic, N. J.

OKONITE OKONITE SINCE 1878 **insulated wires and cables**

THE BEST CABLE IS YOUR BEST POLICY

ELECTRICAL WORLD Editorials

JUNE 19, 1948

Economies of Reheat

FUEL IS COSTING so much more that any thermal economy which can be achieved is very much worth considering. Admittedly, the same can be said of any other costs or any other savings; but in the case of fuel, it is only bought once and burned once. What is not saved then is lost and any saving is important—even if it profits only a fraction of a mill per kilowatthour generated.

Reheat of the steam at the boiler after it has given up some of its energy in the turbine is a promising and profitable way of using fuel heat efficiently and advantageously. Most fortunate about this technical trick is that the saving in fuel can pay as neat a return as 23 to 24 percent on the added investment in turbine, boiler, piping, etc. Nor is it an untried measure, inasmuch as 9 of the 113 plants analyzed in ELECTRICAL WORLD's forthcoming Fifth Steam Station Cost Survey have a reheat cycle.

What is the potential gain and at what cost can it be accomplished? To approach the problem, assume a 62.5/75 megawatt plant operating at 61 percent load factor and consuming fuel that costs 34 cents per million Btu. Those are representative figures attested by the survey mentioned. Such a plant operating at 1250 psi and 950F will be burning $1,500,000 worth of coal and should be attaining a thermal economy of approximately 11,000 Btu per net kilowatthour.

A 2.6 percent better job could be done by adopting 1450 psi and the 1000 F temperature now justifiable (1050 F has been chosen for some recent plants). Of this gain, 1.1 percent can be attributed to the higher pressure and it is not likely that either the boiler or turbine will be appreciably more expensive on this account. The other 1.5 percent is attributable to the higher temperature and this may entail a $50,000 greater outlay for the turbine and $80,000 for the boiler. But the efficiency should advance to 10,715 Btu, carrying the fuel expenditure down to $1,460,000. The annual saving of $40,000 returns about 30 percent on the incremental investment. That is why it is being done.

But an equally attractive contribution can be obtained from tapping off the steam after it has dropped to the 600 F point in the turbine and passing it back to the boiler for restoring its state to 1000 F by impartation of the requisite heat energy. The 5 percent betterment thermodynamically achievable should bring the Btu per kilowatthour down to 10,185 and the fuel bill down to $1,385,000. The dollar saving against the "once-through" 1250/950 cycle is $115,000 a year. Probably the boiler and turbine may each cost $225,000 more. There will be more piping but it can be assumed that its cost will be offset by less expensive pumps and condenser. So there is an added $75,000 to pay a further return of 23.5 percent on the $320,000 added outlay to outdo the mere upping of temperature and pressure by reheat.

It is this sort of thinking which undoubtedly accounts for the ten or more commitments understood to have been made already this year for reheat plants to be functioning early in 1951. Better appreciation of the inherent advantages may very appropriately influence some of the pending negotiations for sites where fuel costs are discomfitting.

Doesn't Know, Doesn't Want To Know

INTERIOR SECRETARY JULIUS A. KRUG has the best excuse in the world to resign his Cabinet post this week. Krug's boss, a political candidate named Truman, has defiled the greatest job Krug ever did.

In Seattle, Candidate Truman spoke of a private utility, manifestly the Pacific Gas and Electric Co, "which has so little faith in the future of the west that it failed this spring to be ready to furnish vitally needed power. As a result, the whole of northern California had to resort to a brownout."

ELECTRICAL WORLD has believed for a long time that ultimately, some one would try to impugn the magnificent war power supply job which the Office of War Utilities did, along with the power systems of the country. We had guessed the attack would come from one of the federal power trust's small bore hatchet men. We just had the address wrong.

Since we know a good deal about the OWU job, and since Mr. Truman either doesn't know or doesn't want to know the story on power supply, we'll tell him what happened. It goes like this:

Northern California had a brownout this winter and spring. Its direct cause was a woeful deficiency in water supply to operate hydroelectric plants. That the water shortage became a power shortage was due to the fact that PG&E was short of steam-electric capacity. The reason PG&E was short of steam capacity was that in 1944 and 1945, the Office of War Utilities resolutely refused to give priorities for steam-electric plant which the company wanted in the worst way. That equipment, which was refused by the government, would have been operating in time to prevent the brownout in California.

The equipment was refused deliberately, although reluctantly. Similar pleas were refused companies in Chicago, Wisconsin, and other places where there have been power supply difficulties. This was done because every last bit of material which WPB gave OWU for allocation was consumed in filling the requirements of a few systems which seemed to be just a little more in need than were those which were refused. It was a deliberate, calculated policy. It was ordained in the first instance by Krug and followed honestly and fearlessly by the capable group of power system engineers who made up OWU. It stemmed from a hard but brilliant decision which Krug made earlier in the war—to cut the power program in half so the Navy could have ships, the nation could have rubber, munitions and—although we didn't know it then—the atomic bomb.

That policy hit the electric power industry hard during the war, but it was accepted and lived under. It was right when it was invoked because it was one of the things which helped win the war. Since then, that policy has proved a scourge to the industry, and it will continue to be so for several years more. Yet it has drawn no complaint from the people who suffered most under it—the electric power industry. It should draw none from ANY candidate, not even one aspiring to the Presidency.

Wanted: Teachers

Engineering educators want capable teachers. ELECTRICAL WORLD recently surveyed colleges and universities to find what they can do to fill the manpower needs of the electric power industry. If our survey showed anything, it showed the pressing need for teachers, highly-trained and competent. And it follows that there will be no full flow of recruits unless dynamic teaching manpower is found first.

A trickle in this direction may be seen. In its van are the two Lewises, Bewley, Whitehead, Vogel, McCann and Clarke. But there must be many more like them. The utilities themselves will have to contribute—heavily. Otherwise, our survey shows, the manufacturers will command the cream of those students who do not choose light—current work.

Is it inconsistent to speak in one breath of utility recruiting and in the next of transferring utility men to the faculties? Whatever the answer, the need is real. It will take inspirational instruction in the power field to provide annual crops of power-trained engineers for utilities.

We hope that in recruiting their teachers, the colleges and universities will require more than just sound engineering. The schools are—or should be—seeking a new galaxy—men like Jackson, Scott, Karapetoff, Adams and Kennelly. It is men like these who will solve the dual problem—that of teachers AND recruits.

Commission Bites Scientists

ELECTRICAL WORLD has followed more or less closely two of the persistent philosophic struggles which have been part of U. S. experience with atom control. One is the bitter resentment of the scientist toward anything approaching military control of the atom. The other is the reiterated plea that atomic security not hamstring the interchange of information which scientists hold so dear. Having followed these struggles thus closely, we get a mild chuckle from the following excerpt of a Commissioner Pike speech.

"It is interesting to note that the Commission depends heavily on the scientists for defining, within their own fields, the areas which should be open to the world and those which should be kept under varying degrees of security. In this work, they have turned out, as might be expected, to be just as human as the rest of us. While expressing resentment in general, each group in its own particular field has tended to be extremely cautious about recommending the release of information. This, I might say, causes the Commission both some concern and some amusement, since it is commonly thought that only the military mind tends to keep everything TOP SECRET. The Commission is thinking of issuing a low but determined growl at some of our scientific personnel to see if we can't shake some more information—especially engineering information—out into public view."

Don't just growl, Commissioner. Bark like mad.

NEWS OF THE ELECTRICAL WORLD

The Electrical Week

A Philadelphia-bound Congress was finishing appropriation bills with a big rush this week. The outlook was for record-breaking grants to federal power agencies. But TVA's New Johnsonville money, though ok'd by the Senate, faced a bitter conference dispute and probable defeat there...In Scranton, the PEA's prime mover committee heard discussions centering on soot, silica and anthracite....GE is urging utilities and manufacturers to push a three-point plan to build industrial electrification. It was presented at the Sacandaga, N. Y. Industrial Power Sales Conference which was held last week...And in Chicago, Mayor Kennelly and Commonwealth Edison both have accepted the new 43-year franchise, making it effective.

Here's a Congressional reaction to the "hush-hush" hearings on Atomic Energy Commission funds. It paraphrases the attitude of AEC witnesses.

The word "uranium" means the "sky,"
That's why our budget is so high;
For when we work with things atomic,
We never could be economic.
We deal with matters scientific.
(Don't ask us to be too specific.)
Mesons, protons, neutrons, fission,
Are just shop talk, not erudition.
Our testimony's vague, but calm.
Your job's the budget; ours, the bomb.
We walk on clouds (of radiation).
You save the cash; we'll save the nation.

This was written by Rep. John Phillips, California Republican and a member of the subcommittee hearing AEC appropriation requests.

Harold Kramer, chairman of the board of the Nebraska Public Power System and general manager of the Loup River Public Power District, says Loup is considering refinancing its $10,000,000 federal loan with private funds. The Central Nebraska district also is considering refunding. Rate revision is also under study.

One utility leader who's close to the coal industry gives this prospect for the forthcoming contract expiration June 30: "Endless negotiation, endless litigation—and no coal."

They don't work all the time, but John Lewis' miners certainly dig coal when they work. From April 17 to May 29, soft coal output was 2,795,000 tons greater than during the corresponding period in 1947. Percentagewise, 1948 production is now 13% behind last year's for the comparable period. At the end of the most recent strike, it was 19% behind last year.

Fears of metal scarcities resulting from the government's stockpiling program have industries scrambling for all available metals. The problem: No one knows what the government is buying or what its future plans are.

Despite California's curtailment program, PG&E recorded energy deliveries during the first quarter which were 15% above those of the comparable period in 1947. Most of it went to farmers. Their consumption rose 138%.

In 1947, electric range sales set a record with 1,200,000 installations. But the L.P. bottled gas people topped this figure by 400,000.

Defense Secretary Forrestal has been getting telephone calls from the Capitol demanding that he help pro-TVA legislators get the initial $4,000,000 appropriation for the New Johnsonville steam plant. It's an old Washington practice, just as it's an old practice to transcribe all such calls. The way we hear it, Tennessee's Sen Tom Stewart is generating most of the steam on New Johnsonville phone calls.

SEC Commissioner Richard McEntire is another who foresees power expansion well beyond today's program. Writing in Public Utilities Fortnightly, McEntire said in part that "...the industry appears to face a long period of large-scale expansion, rather than a definite 4-year program as was assumed a year ago."

Adjournment Rush Funnels Funds To All Federal Power Systems

WITH CONGRESS scrambling to quit Washington, it appeared at midweek that federal power agencies had won a record dollar total in appropriations for fiscal 1949. Policywise, however, it was a different story.

Major power policy decisions of the present session of Congress involved proposed federal steam plant construction, principally by the Tennessee Valley Authority. TVA apparently had lost its bid for Congressional approval of a thermal plant at New Johnsonville, Tenn. A less serious effort by the Reclamation Bureau for a steam plant on its Central Valley (California) project already had been squelched.

More than $1,250,000,000 for agencies concerned with construction and operation of electric power facilities was involved in four major appropriation bills pending as the week started. Congress swiftly disposed of two—those containing funds for the Rural Electrification Administration and the Army's Engineers. Bitter House-Senate disputes loomed, however, over funds for TVA and the Interior Department.

An abortive revolt by a badly outnumbered economy bloc in the Senate, followed by a House-Senate conference squabble, had delayed final approval of the Army Civil Functions bill for more than a month. Most of the total of $641,575,000 carried by the measure as it was sent to the White House this week was earmarked for development projects of the Engineers. The Engineers received a total of $405,741,100 for Flood Control construction and $166,989,100 for Rivers and Harbors work.

The only REA funds at stake in the Agriculture Department appropriations bill, which also cleared Congress, was a $450,000 Senate boost—to a total of $5,450,000—in the lending agency's administrative funds. The compromise on this measure found the House agreeing to the REA increase. Both the House and Senate previously had approved a $400,000,000 fund for REA loans during fiscal 1949.

Principal power issue of the year continued to be the TVA request for $4,000,000 to start construction of the New Johnsonville plant. This request was rejected by the House, but the funds were restored in the $70,000,000 Government Corporations bill approved by the Senate Appropriations Committee. Outcome of the battle was still in doubt, but the House seemed determined to stand firm in opposition to the steam plant in conference on the measure.

Otherwise, TVA funds were not affected by the late Congressional action. Despite the Senate's proposed addition of the $4,000,000 item, it was estimated that the net increase in total TVA appropriations would amount to only $3,583,000 above the House-approved total of $27,389,061. The Authority reported to the Senate that it expected to have sufficient additional carryover funds from previous appropriations to cover a $417,000 reduction below the House estimates for its over-all expenditures.

Also in doubt at midweek were several fiscal and policy decisions involving power agencies of the Interior Department. The Senate approved a total of $422,000,000 for Interior, as compared with the $375,692,000 recommended by the House.

Senate OK's Rider

Most surprising development as the Senate passed the Interior bill on June 14 was its approval of a House rider which apparently will force the resignations of the Reclamation Bureau's Commissioner Michael Straus and California Regional Director Richard Boke. Of the 34 senators representing states in which the Bureau operates, only one, Sen. Joseph O'Mahoney, Wyoming Democrat, spoke against the Straus-Boke ouster during the Senate debate. O'Mahoney and Sen. Carl Hayden, Arizona Democrat, also wrote a minority committee report opposing the rider.

Reclamation Bureau proponents had confidently predicted that the western Senate bloc would kill the ouster movement. Straus, long a vehement advocate of federal power expansion, had mustered considerable administration support, including that of Secretary Krug, during the Senate committee hearings.

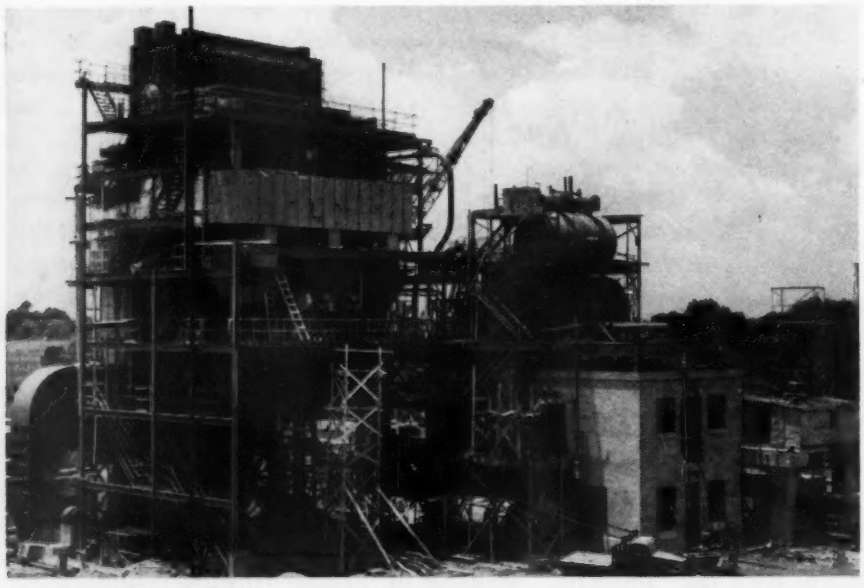
Give-Take on Funds

But the committee's version of the ouster merely modified the language of the House proviso, which forbade salary payments to a Reclamation Commissioner, Assistant Commissioner or Regional Director who was not a "qualified engineer" of 10 years' experience. Neither Straus nor Boke is an engineer.

The House would have made this qualification effective at the start of the fiscal year on July 1. The Senate committee changed the effective date to next January 31 and demanded that the Reclamation chiefs have only 5 years' experience.

The annual House-Senate give-and-take game over funds for Interior's Division of Power seemed destined for its usual wind-up. The House canceled the full $104,610 budget request of the Division, but the Senate allowed the agency $75,000. The Senate was expected to win the conference fight.

The Senate also proved more liberal with the Bonneville Power Administra-



NEARING COMPLETION—Trial operations of the first 30,000 kw unit for the new Rex Brown station of Mississippi Power & Light Co will be made this summer. The outdoor type station is the first for this company. Its 350,000 lb per hr boiler will be gas fired. The view shows the induced draft fan at lower left, the steam generating unit, the deaerator and the control building. At extreme right is turbine pedestal. Another 30,000 kw. unit is on order for the $4,500,000 plant

tion. It allowed BPA $21,125,700 in cash and $12,046,500 in contract authorizations, as compared with the House totals of $20,920,760 and $10,269,290. The Senate boosted BPA operating and maintenance funds by $231,800—to a total of $3,231,800—to permit the hiring of additional "maintenance workers."

The entire addition of $1,777,210 in BPA contract authorizations was earmarked by the Senate Committee for expanded construction of transmission facilities, although actual cash for this purpose was reduced below the House-approved total. The Senate group also disagreed with the House in allowing a $170,000 payment by BPA to the Puget Sound Power & Light Co for purchase of the utility's Beverly Park-Snohomish transmission line.

No increase was made in the $260,000 allocated to the Secretary's office for administrative expenditures of the Southwestern Power Administration.

The Senate upped total appropriations for the Reclamation Bureau from the House figure of $226,794,897 to a total of $254,442,855. An increase of $2,467,000 was included for construction on the Central Valley project, raising the total allocation for that job to $42,467,400. Other major increases for Reclamation projects voted by the Senate follow:

Project	House Total	Senate Total
Hungry Horse	$8,100,000	$15,115,500
Davis Dam	18,000,000	22,884,300
Colorado-Big Thompson	19,750,000	20,700,000
Fort Peck	990,000	1,980,000

The Senate agreed with the House figure on total funds for the Columbia Basin project, $45,312,000. But it eliminated entirely an item of $150,000 alloted to the Reclamation Bureau for power surveys in Alaska.

•

New Johnsonville Gets Approval by Senate

The Senate approved TVA's bid for the New Johnsonville steam plant this week (June 15) by a 45-37 vote. Action came as both houses sped toward an end of business and departure for the GOP convention next week.

Settlement of the New Johnsonville issue for this year was to come from a joint conference committee on the Government Corporations Appropriation bill, which contains the New Johnsonville item. There were numerous indications that House conferees would refuse the Senate's decision on it. Some observers predicted a long conference if the Senate insists. The bill must be enacted by June 30 if the agencies are to have funds.

Soot, Silica and Anthracite Are Topics of PEA Prime Movers

DISTINCTIVE FEATURES of the new anthracite-burning boiler for Scranton Electric's new 25/32.5 Mw unit at Suburban station embrace triple-fuel bunkers and provision for reburning of stack-dust isolated by the Koppers precipitator. Details were given by A. R. Weismantle of Foster-Wheeler and L. B. Schueler of American Gas & Electric Service Corp. to the prime movers committee of the Pennsylvania Electric Association in Scranton, June 10, 11. The fuel can be buckwheat, anthracite silt or bituminous directly from respective bunker sections. The recovered stack dust is burned on a sloping grate at the bottom of the furnace.

Discussion of air vs steam for furnace soot-blowing brought out the opinion that air is preferable if cleaning has to be done frequently and in high-pressure stations to avoid increased blowdown for silica elimination. Air was called more expensive to instal but contributes to reduced boiler maintenance. Recommendations of manufacturers as to size of system was reported as varying widely.

Sentiment favored removal or abandonment of soot blowing in economizers because well-disposed tubes appear to be adequately self-cleaning.

Silica deposit on turbine blades in the 500 F region was traced by several members to seals and other previously unsuspected sources. In one instance it was blamed on flyash getting through the breather of a condensate storage tank on the roof. Increased blowdown merely necesitated more contaminated makeup.

Graphitization of a welded carbon-steel pipe joint is being corrected in one plant by 3-hour heating by induction to 1700 F followed by 700 F and finally 1250 F. The graphite diffuses.

Dissatisfaction was expressed about the performance of evaporators and the prevailing rating practice. Many have to be run at half capacity or less to get a sufficiently clean output.

Excessive rolling of tube ends was reported as controlled by a new electronic device with automatic torque limitation.

Practice of starting two or more high-voltage auxiliary-drive motors on one breaker to minimize breaker expenditures is being deprecated, on the operating side, at least for pulverizer exhauster fans. It necessitates shutdown to isolate a defective motor or fan.

Much study is evidently being given to lengthening the life of induced-draft blading.

Condenser tube breaks in one plant were traced to improper alignment of the plates.

The group was given a condensed preview by A. E. Knowlton of the 5th Steam Station Cost Survey to appear as an insert in the July 3 issue of ELECTRICAL WORLD.

The committee group visited an anthracite mine as well as the Suburban and Stanton plants.

THIS IS ONE of the common ways in which Chinese utilities move poles on construction jobs. Twenty-four coolies are carrying this pole through the streets of Chungking. Using this method, every American utility would go bankrupt

3-Point Plan for Raising Industrial Electrification Set Up at GE Meeting

A THREE-POINT PROGRAM by which utilities and manufacturers can help industry increase its electrification was outlined last week at the Industrial Power Sales Conference at Sacandaga, N. Y. The two-day conference was sponsored by General Electric Co and was attended by 125 utilities' executives plus GE personnel.

The program, outlined by F. M. Roberts, assistant manager of the GE Industrial Engineering Divisions, calls for utilities and manufacturers to:

1 Show purchasers how they can profit from new electrical apparatus.
2 Convey electrical ideas to customers in terms of "industry language," understanding, and objectives.
3 Select that combination of electrical equipment that can do the job best.

At the same forum, W. V. O'Brien, assistant manager of the GE apparatus sales, pointed out that "the production of electrical apparatus is at an all-time high." GE has appropriated more than $2,500,000 for new facilities in the Apparatus Department alone. Manpower and materials are available to maintain production "at a maximum rate."

Industrial customers used more power last year than was generated by electric utilities in 1940, L. A. Umansky, assistant manager of the GE Industrial Engineering Divisions, declared. From 1929 to 1947, the number of production workers in manufacturing and mining industries increased from 8.5 to 12.5 millions, or 50%. But each man now uses 12,000 instead of 7,500 kwhr per year.

"Electrification of industry," he asserted, is a far greater task than a mere increase of an amount of electric power used. A plant, which many would call 100% electrified, may be the most fertile ground for additional or new electrical equipment."

Gradual exhaustion of natural oil supplies has led the attention of industrial planners to production of synthetic fuels. A synthetic liquid fuel program of 2 billion barrels a year would require almost as much power, largely from mechanical-drive turbines, to produce as is now generated by the entire utility industry, T. R. Rhea, manager of the GE Chemical and Petroleum Division, predicted.

At a session based on GE's More Power to America Program, G. N. Hawley, manager of power sales for the Southern California Edison Co, called for "the championship of the merits of electrification in every legitimate field of application."

The future of the electrical industry, he said, is wrapped up in four factors:

1 Technical skill in developing and making available the constantly increasing amounts of electricity associated with a rising standard of living.
2 Completeness of integration with the communities served.
3 Success of our collaboration with our colleagues within the industry —manufacturers, distributors, dealers, and contractors.
4 The potency of our advertising and the effectiveness of our sales organizations.

"Our problem in the face of new and challenging conditions," he said, "simmers down to the job of getting new and more efficient machinery into the hands of workers and teaching them how to operate it effectively."

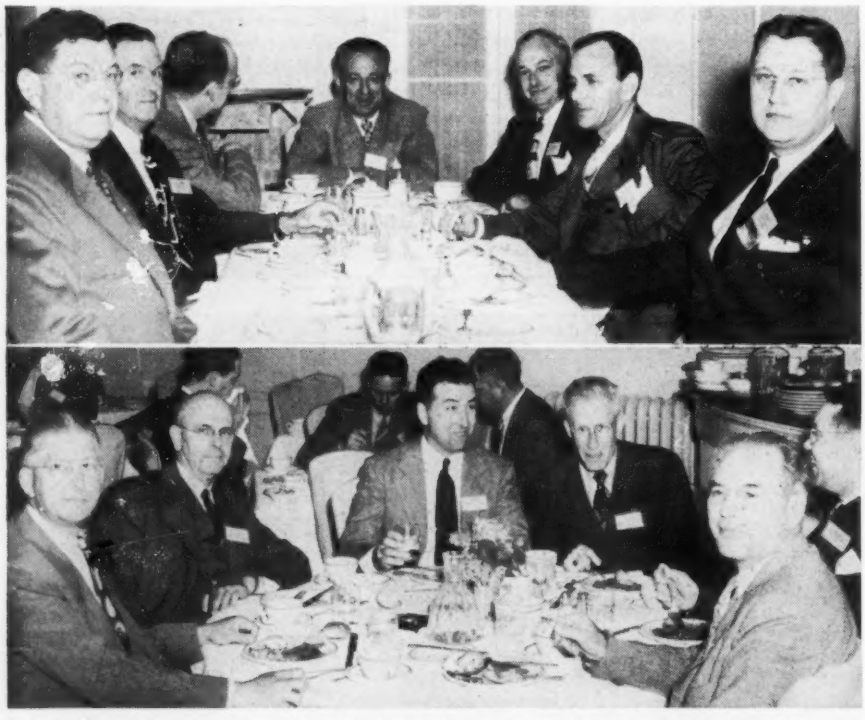
J. S. Smith, manager of the GE Apparatus Department's Advertising and Sales Promotion Divisions, advocated the use of visual aids, particularly films, as the most effective means of giving industrial customers full appreciation of the benefits of new electrical processes, techniques, and equipment.

George Tenney Speaks

George Tenney, acting editor of ELECTRICAL WORLD, emphasized that the utilities have a legal, moral, and economic responsibility to provide electrical service. Their moral responsibility, he said, hinged on whether they have the capacity to supply new customers and whether they can provide power to new users without depriving established customers.

He pointed out that utilities are legally bound by a franchise and economically bound by "good business practice" to supply power to industrial customers. "A failure to follow these obligations," he declared, "is to invite disaster."

Touching on the future use of atomic power in industry, H. A. Winne, vice-president in charge of engineering policy for GE, said that nuclear fission will be used merely as a source of heat. No direct conversion of atomic energy to electricity seems possible.



CALIFORNIANS AND McGRAW-HILL magazine representatives predominate at this table (top) at the Industrial Power Sales Conference at Sacandaga, N. Y. Around the table, left to right, are N. R. Sutherland, Pacific Gas & Electric Co; J. C. Porter, General Electric Co, San Francisco; Kenneth Kramer, *Business Week;* George Tenney, president of McGraw-Hill Co of California; G. N. Hawley, Southern California Edison Co; Ralph H. Flynn, publisher, ELECTRICAL WORLD; J. S. Smith, GE, Schenectady. New Englanders in lower panel are W. D. Wilkinson, New England Power Service Co; C. R. Broadhead, Narragansett Electric Co; A. J. Moore, GE, Providence; E. D. Learned, Worcester County (Mass.) Electric Co; H. S. Beaudoin, GE, Boston; and H. W. Murdock, GE, Boston

Chicago Franchise Effective; Commonwealth Spurs Financing

ITS NEW FRANCHISE approved by Mayor Kennelly last week, (June 11), Commonwealth Edison Co hastened to accept the 43-year contract and to get on with its financing program, delayed for months by the franchise negotiations.

The company plans to float a $50,000,000 bond issue this month as first step in raising the $175,000,000 of new money it has estimated will be required by its six-year, $360,000,000 expansion plan.

Kennelly Seeks Cut

Kennelly's approval of the pact was accompanied by a suggestion that Commonwealth cut residential and commercial rates. Kennelly pointed to a franchise provision which requires the company to be diligent about keeping its revenues as close as possible to the cost of providing service—including a fair return. This stricture upon the company, he said, plus its earnings picture, point to a rate cut for small users.

One of the new franchise provisions will establish on the Commonwealth system a condition which has long been sought by the federal administration and which is a burning political issue today—anti-discrimination policies in all employment. This franchise clause forbids the company to "discriminate against any person employed or seeking employment with respect to hire, tenure, promotion, terms, conditions or privileges of employment on account of race, color, religion, national origin or ancestry, including, without being limited to, any employment practice whereby licensee or any agency engaged or used by licensee makes inquiry with respect to the race, color, religion, national origin or ancestry of any applicant for employment by licensee."

May End Franchise

The franchise may be terminated by the city on one year's notice if the company fails to remedy any breach of this anti-discrimination clause within 180 days after any court of competent jurisdiction shall have found that it was breached and ordered it remedied.

This provision is the heart of the Fair Employment Practice Committee set up during the war by Executive Order of the late President Roosevelt, aimed at halting employment discrimination in the war effort. It is part of the violently-controversial "civil rights" program proposed recently by President Truman and fought bitterly by many southern political leaders. It is the heart of the fair employment legislation which was supported by the 1944 Republican platform and which has been reiterated several times since in Congress.

Electrical World Photo by Meier

GOOD FIGHT Aldermen Clarence P. Wagner, left, and Robert A. Merriam agree after the Chicago City Council had voted a 43-year franchise to the Commonwealth Edison Co. Wagner led the fight for the franchise, Merriam fought against it

Another unusual franchise provision is that setting the formula by which Commonwealth's property would be valued should the city decide to municipalize its power supply. The company is required to sell on one year's notice by the city ". . . for a cash consideration equal to the cost of reproduction new of licensee's utility facilities, minus the depreciation in licensee's utility facilities . . ." Depreciation shall be the same proportion of reproduction new as the depreciation reserve at the time of taking bears to investment in electric plant. Inclusion of "reproduction new less depreciation" as the standard for valuing the property in an acquisition probably will come as a heresy to those utility accounting specialists of the federal government who have labored for years to expunge this doctrine.

•

Duquesne Write-Off OK'd

FPC has approved a Duquesne Light Co proposal for eliminating $2,453,927 from its plant account. The item represents unreported retirements and affiliated company profits. Duquesne will charge $2,319,298 to reserve for depreciation of plant in service. The remainder will be charged to earned surplus.

Kansas City P&L Plans Emergency Curtailment

Anticipating peaks that may exceed the capability of its plants and interconnections in event of loss of a large turbine or boiler, Kansas City Power & Light Co has a plan to curtail service.

If the loss should occur when the load is near peak, the first step would be to drop voltage and one large step-up substation which supplies service over 33-kv lines to suburban and rural communities. This would be followed immediately by calls for voluntary power curtailment and dropping of residential load in area rotation so as to restore suburban and rural service.

If greater curtailment is necessary, each operator of an air conditioning installation, 5 hp or over, will be notified in writing to restrict operation on the following day. The utility will select five hours or less between 7 AM and 5 PM when air conditioning may be used. In this event, consumers receive a credit of 5 cents per kw of demand for each hour service is curtailed.

The Public Service Commission has authorized the curtailment of air conditioning service. Such procedure will be followed before industrial load is curtailed except voluntarily.

•

Non-Partisan Support For Northwest Dams

Broad industry support from public and private power system operators in the Pacific Northwest has been pledged to the National Security Resources Board in an attempt to speed power construction in the Northwest.

The pledge came after meetings in Washington last week (June 7, 8, 9) attended by representatives of all power systems in the region. As a result of the unanimous recommendation of this group, it was hoped NSRB would command administration support for new authorizations and additional appropriations affectings several projects.

Those recommended by the joint conference:

McNary Dam, with additional funds sought in a pending deficiency bill; Albeni Falls Dam, authorization sought so it will be available as storage to bolster downstream plants; Detroit Dam, seeking authorization for a power house at this dam on which work has started; Hungry Horse Dam, seeking additional funds to speed work; Yakima Ridge and Chandler Dams, seeking additional funds.

Prospects that much could be done on this program before Congress left town for the GOP convention were very slim. The Senate, however, added

$7,000,000 to the Hungry Horse funds, raising them to $15,000,000 and easing concern on this project. The Budget Bureau, the Administration's spending watchdog, reportedly was objecting to additional funds.

The conference also declined to recommend a number of projects which had been proposed to it for recommendation.

If the recommendations are adopted, it was believed McNary could be brought in during 1953, Albeni's storage during 1951 and Detroit and Hungry Horse in 1952.

The meeting grew out of NSRB's concern over the fact that the Pacific Northwest is the only region in the country where (a) a power deficiency is in prospect and where (b) the present construction program is insufficient to meet the prospective deficiency.

•

Utility Buys Installations

Texas Power & Light Co has purchased the electric power installations at Owentown, formerly Camp Fannin. The equipment includes poles, lines, transformers, and other items. The seller was the Owen Development Co. The price was $21,902.

•

Votes 25-Year Franchise

By a vote of 766 to 6, citizens of Jennings, La., have voted the Gulf States Utilities Co a 25-year franchise to furnish the city electricity and gas.

REA Sets Up New Group Handling Power Supply

Rural Electrification Administration reshuffled its management and engineering units last week (June 8) to come up with a new Power Division. The new organization will take over all REA activities involving planning and operation of generating and transmission facilities.

Administrator Claude Wickard emphasized that the reorganization move points toward no increase in REA lending for construction of generating plants. On the other hand, the new set-up admittedly will allow swifter handling of applications for such loans, as well as for other power supply matters involving REA borrowers.

Administrative organization of the Power Division also indicated new REA attention to power supply in general and generating systems in particular. Three sections are provided under the new unit. One, the Procurement Section, will deal with power sources, wholesale rates and contracts, and service to REA borrowers by wholesale energy suppliers. The Generation and Transmission Design and Construction Section will give technical assistance to borrowers in building their own generating and transmission facilities. The Generation and Transmission Management Section, as its name implies, will advise on the operation and maintenance of such facilities.

James B. McCurley, Jr, chief of REA's Technical Standards Division, was transferred to head up the new power unit. McCurley, who joined the REA staff in October, 1946, previously had served with the Navy and was engaged in electrical engineering research both at Annapolis and at the Naval Ordnance Laboratory, Washington. Earlier he had been employed on the engineering staffs of the Western Electric Co, Chesapeake and Potomac Telephone Co, Consolidated Gas, Electric Light & Power Co of Baltimore and Brooklyn Edison Co.

Assistant chief of the Power Division is John M. Duncan, who has been with REA's Engineering Division since 1941. Milton Chase, who headed the planning group of the old Generating and Transmission Section, will act as coordinator for the new division.

Another transfer from the old Generating and Transmission Section brings Ivan A. Bosman to the Power Division as head of the Generation and Transmission Design and Construction Section. Bosman headed the Internal Combustion Unit of the G & T Section. Franklin P. Wood, Chief of the G & T Section, becomes head of the Generation and Transmission Management Section. The Power Procurement Section is headed by George A. Ball, veteran rate engineer of the agency.

Joseph E. O'Brien succeeds McCurley as chief of the Technical Standards Division. He has been assistant chief since December, 1946. A graduate of the Catholic University and former assistant professor of Electrical Engineering at that institution, O'Brien has been associated with REA since 1940, when he served as a part-time consultant for the agency. He became a member of the Technical Standards Division staff in January, 1946, after war service as a Marine Major.

•

2 New England Utilities Will Increase Capacity

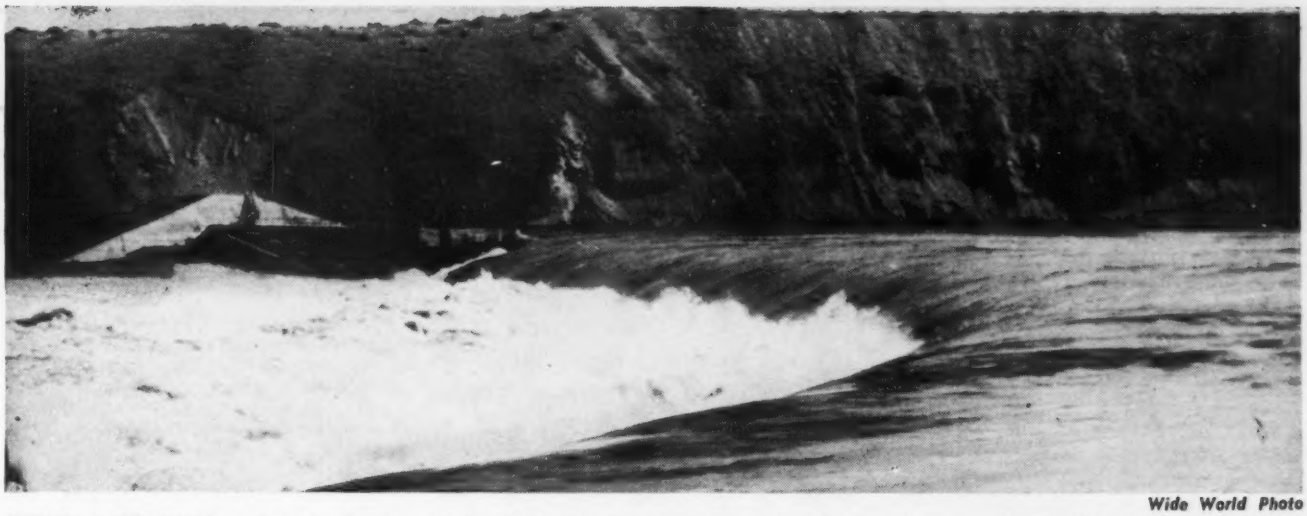
New England Gas & Electric Association and its subsidiaries have announced their expansion plans for 1948-52.

Cambridge Electric Light Co will add a second unit to its Kendall Square steam plant now under construction. The first unit will have a capacity of 20,000 kw, the second of 25,000 kw. The first unit is expected to go into service early in 1949.

New Bedford Gas & Edison Light Co has ordered a 35,000-kw steam unit. A 25,000-kw unit was put into operation last year. A crack developed in the turbine shaft, so this unit will not be returned to service until this coming fall.

Electrical World Photo by Meier

COMPACT AND FLEXIBLE calculating board being assembled in the Underground Department office of Kansas City Power & Light Co. T. G. Hieronymus, left, superintendent of underground and board designer; Robert Turner, seated, engineer; and his assistant, Kenneth Drummond, check component parts. The board is of low voltage ac type. It will have 160 transformer, 160 load, 210 cable, and 48 universal positions. It will be usable on capacities up to 100,000 kva. All component parts are of standard design



Wide World Photo

POWER SHORTAGE is what this picture spells for the Pacific Northwest. The Columbia River is overtopping Puget Sound Power & Light's Rock Island dam, below Wenatchee. Ordinarily, this dam has a 51-foot head

Columbia Floods Bring Warning of Shortage

Pacific Northwest utilities warned their customers this week (June 13) that a critical electric power shortage exists. Consumers were warned further to be prepared for further cuts in energy supply.

The warning came as the Columbia River's third flood crest—this one higher than that which smashed Vanport a few weeks ago—poured into the lower valley.

Adjutant General Ensley Llewellyn, of the Washington National Guard, estimated that damage to power facilities totalled $143,500.

The flood continued to cut down power output as water surged over the top of some dams and raised tailraces everywhere. The Bonneville Power Administration has been able to maintain normal guaranteed deliveries only with the help of the Seattle and Tacoma municipal systems. Output at Grand Coulee and Bonneville was down by 17 and 70% respectively.

Seattle reversed its normal operating rules at this season to send 80,000 kw on peak into the Northwest Power Pool. Tacoma supplied the same amount. Steam plant production had been increased, also. Normally, Seattle impounds water at this season in its Skagit and Cedar River reservoirs.

Bonneville, whose normal head of 70 ft has been cut to 36 ft or below, saw its capability reduced from 565,000 to 155,000 kw. Coulee was off 190,000 kw from its 1,170,000 kw capability.

U. S. Army Engineers had not been able to estimate the damage to its cofferdam at the McNary site, where work has begun on a giant new lower Columbia River plant. Damage in the area was described as "considerable," with a ferry route there suffering hard. Power lines along a canal in the Dalles-Celilo area have been lost, ELECTRICAL WORLD was told.

In the Longview-Kelso area, emergency crews which started as volunteer units have strung 20 miles of emergency lines so that dike workers might have light for night work.

•

Maltbie to Retire As Chairman, New York PSC

Milo R. Maltbie 77-year-old veteran chairman of the New York Public Service Commission, announced this week that he plans to retire. He will submit his formal resignation to Governor Dewey after his successor has been appointed. In the meantime, Chairman Maltbie will take a leave of absence during which time a deputy chairman appointed from among the present members of the commission will serve as acting chairman until a successor is named.

Mr Maltbie was appointed chairman of the commission in 1930 to fill the unexpired term of William A. Pendergast. He was reappointed for a full term in 1931 and to his second ten-year term in 1941, and still has until Feb 1, 1951 to go.

In accepting Chairman Maltbie's notice of retirement, Governor Dewey said: "I cannot allow your service to the State to conclude without a personal word of appreciation. You were appointed and re-appointed by my predecessors. Yet our personal relationship has been so cordial and happy and your attitude toward the State Administration so cooperative that it has been one of my happiest experiences."

Savannah River Power Will Pursue Clark Hill Fight

The Savannah River Electric Co has no intention of giving up its fight for the Clark Hill hydro-electric project on the Savannah River, even though it has given up its attempt to keep the government from occupying land it assembled for the reservoir.

Vice-president Charles A. Collier told ELECTRICAL WORLD that ". . . we have not given up the fight and are still contending for the right at least to build the power house with its requisite machinery; to operate it; and to purchase falling water from the federal government in accordance with the bill now in committee of Congress known as HR 3826. We are still actively pressing for approval of this bill and hope that it may be enacted into law."

•

Louisiana Company Will Open Outdoor Station

What is believed to be the first completely outdoor steam power station in the country is being completed in Louisiana. Officials of the Central Louisiana Electric Co hope to put it into operation June 30.

Located between Bunkie and Ville Platte, on the Bayou Cocodrie, the plant will have both turbines and boilers outdoors. It will be named for President F. Hugh Coughlin, and will have two 7,500 kw turbines. Construction began just a year ago. Some transmission work was included.

Complete outdoor design is believed to have been used in only one other plant, that one which was designed during the war for erection abroad under the war aid program.

Atomic Secrecy Hit, Funds Cut $48 Million

The House paused long enough in a mad adjournment rush last week (June 9) to pass and send to the Senate an Atomic Energy Commission appropriation bill from which it cut $48,150,000. It left unscathed an item for contract authorizations amounting to $400,000.000. House members were unhappy about the vagueness of AEC testimony supporting its $550,000,000 request for fiscal 1949.

The Senate was even less calm this week (June 15) as it opened hearings on the bill, which contained a total of $5,795,000,000 in cash for AEC, the Veterans' Administration and other independent federal agencies. The telescoped proceedings of the Senate, which was trying to clean up its urgent business in a hurry, were expected to lead to a restoraton of AEC's full budget request.

Cuts made by the House at the recommendation of its Appropriations Committee followed a scathing committee denunciation of AEC's explanation of its budget requests. The group charged the agency with refusal to supply data based on "technical information which can be available only to the Commission because of the scientific and secret character" of its work. Feeling among members of the committee was that AEC had "taken advantage of its strategic position" in this respect to conceal "general extravagance," the group added.

Only two itemized reductions were made in the AEC budget. One was a cut of $6,400,000—to $26,473,213—for the agency's administrative work. The other lopped $2,700,000 from the $29,122,000 sought for operation of AEC's several project towns. The remaining $39,000,000 of the total reduction should be "absorbed in other items without affecting the military phases" of AEC's program, the committee directed.

•

NY Commission Controls Charges for Service

Charges for service work on electric and gas appliances are regulable in New York state, the Public Service Commission has ruled.

Based on an opinion by NYPSC Chairman Milo Maltbie, utilities charging for such services will have to include the rates in their tariffs by Aug. 1. Filing must include rates for each item of work performed.

The ruling grew out of the practice some companies have adopted recently of charging for such work, the PSC said, in an attempt to boost revenues. Maltbie's opinion held that such charges could constitute a new and unregulated source of utility income. This might mean, to a degree, he held, avoidance of rate regulation. Under the new filing, customers will know precisely what this work costs and whether the charge is reasonable, PSC said.

•

UE Snubs Westinghouse, Accepts GE Pay Offer

The UE-CIO had accepted one and rejected one wage increase offer from major employers this week (June 14) as the electrical manufacturing industry fell into line on the "third round."

UE's general conference board recommended that local unions take General Electric's 8% wage boost proposal. It rejected Westinghouse's 6% offer as "far below" that offered by other major employers in the industry. In addition to the 6% boost, Westinghouse offered an additional paid holiday and an expanded social security program. Westinghouse estimated the cents-per-hour benefits of its proposal at 12.4 cents. GE raises run from nine to more than 15 cents per hour. Its proposed contract runs for two years.

GE made its offer after the General Motors settlement broke industry-wide resistance to the third round increases. Its offer came after repeated declarations by GE officials that an increase in costs would jeopardize the price reduction program it began last New Years Day. There was no GE comment on the possibility that these increases will force cancellation of the price cuts which have been made so far this year affecting its light and heavy products.

Westinghouse' 6% wage offer would average 7.9 cents for hourly-paid employees, the company said. The new holiday—Washington's birthday—would be equivalent to half a cent per hour, and the expanded pension and insurance program would cost about four cents per hour per employe.

•

Suspends Rate Increase

FPC has suspended a proposed increase by Minnesota Power & Light Co and a subsidiary, Superior Water, Light & Power Co, in wholesale rates. The changes will be examined in an FPC hearing. The new rates would yield as much as $54,291 yearly to Minnesota from sales to Superior, FPC said.

SEC RULINGS

COMMONWEALTH & SOUTHERN CORP has been allowed to pay $1.50 per share dividend, amounting to $2,161,870 on its outstanding preferred stock. Stockholders of record at the close of business June 11 will be paid the dividend on July 1. (Release No. 8237).

NIAGARA HUDSON POWER CORP'S request for a six-months extension to Nov 1, 1948 of the time within which it must dispose of all its interest, direct or indirect, in Buffalo Niagara Electric Corp and the subsidiaries thereof, has been granted. (Release No. 8220).

PHILADELPHIA Co, Pittsburgh, has been ordered to dispose of the gas and transportation properties in its $370,000,000 holding company system and then liquidate and dissolve. Under Sections 11(b) (1) and 11(b) (2) of the Holding Company Act, the system, which supplies electric, gas and transportation services to Pittsburgh and surrounding area, can retain only the Duquesne Light Co. However, it also was permitted to retain certain "minor businesses" which were found to be "reasonably incidental, or economically necessary or appropriate" to Duquesne's operations. Among the companies which the SEC specificaly ordered the Philadelphia Co to dispose of were the Pittsburgh & West Virginia Gas Co, the Equitable Gas Co, the Kentucky West Virginia Gas Co and the Pittsburgh Railways Co and its subsidiaries. The Philadelphia Co, a subsidiary of the Standard Gas & Electric Co, presented evidence before the SEC which purported to show that if the electric and gas properties were separated from the system, the annual operating expenses of the companies would be increased roughly $525,000 for the electric group and $500,000 for the gas group. According to the commission's findings, the claimed increases in expenses, even if proven, would not constitute adequate proof of loss of "substantial economies" on segregation within the meaning of the Holding Company Act. "In any event," the SEC stated, "the company's evidence did not establish that the claimed increased expenses would in fact occur on segregation."

CAMBRIDGE ELECTRIC LIGHT Co has been authorized to sell to its parent and sole stockholder, New England Gas & Electric Association, an additional 6,666 shares of $25 par common stock at $150 per share. Proceeds will be used to reimburse Cambridge's plant replacement fund assets account for improvements. (Release No. 8231).

MEETINGS

PREVIOUSLY LISTED

American Society for Testing Materials—Annual Meeting, Book-Cadillac Hotel, Detroit, June 21-25.

American Institute of Electrical Engineers—Summer General Meeting, Palace of Fine Arts, Mexico City, Mex., June 21-25.

Wisconsin High Court Re-opens Co-op Case

Wisconsin's Supreme Court has junked a lower court order which some time ago threw out the state's anti-public-utility-strike law as unconstitutional.

The state high court returned the case to Circuit Judge Alvin Reis for a decision on whether the Dairyland Power Cooperative is a public utility. Reis had held in his decision that Dairyland is a public utility and thus was subject to the state's 1947 utility labor law. But he passed this point lightly to dwell on constitutionality of the new act, which makes compulsory arbitration the Wisconsin method of guarding the public against strike-born disruption of utility service. In strong words, Reis held the law unconstitutional and thus void.

The state Supreme Court overruled Reis by pointing out that questions of constitutionality may only be raised by parties in interest who are affected by the law they question. Neither Dairyland nor the state Employment Relations Board had questioned constitutionality of the compulsory arbitration statute, the high court said. So Reis, the decision went on, was powerless to do so himself.

The case grew out of an injunction suit brought by Dairyland against the Employment Relations Board to forbid the latter from employing the law in a dispute between Dairyland and an International Brotherhood of Electrical Workers, AFL, local. That dispute has since been settled and the co-op had asked that the case be dismissed. Reis' decision had been appealed to the high court by the Employment Relations Board.

•

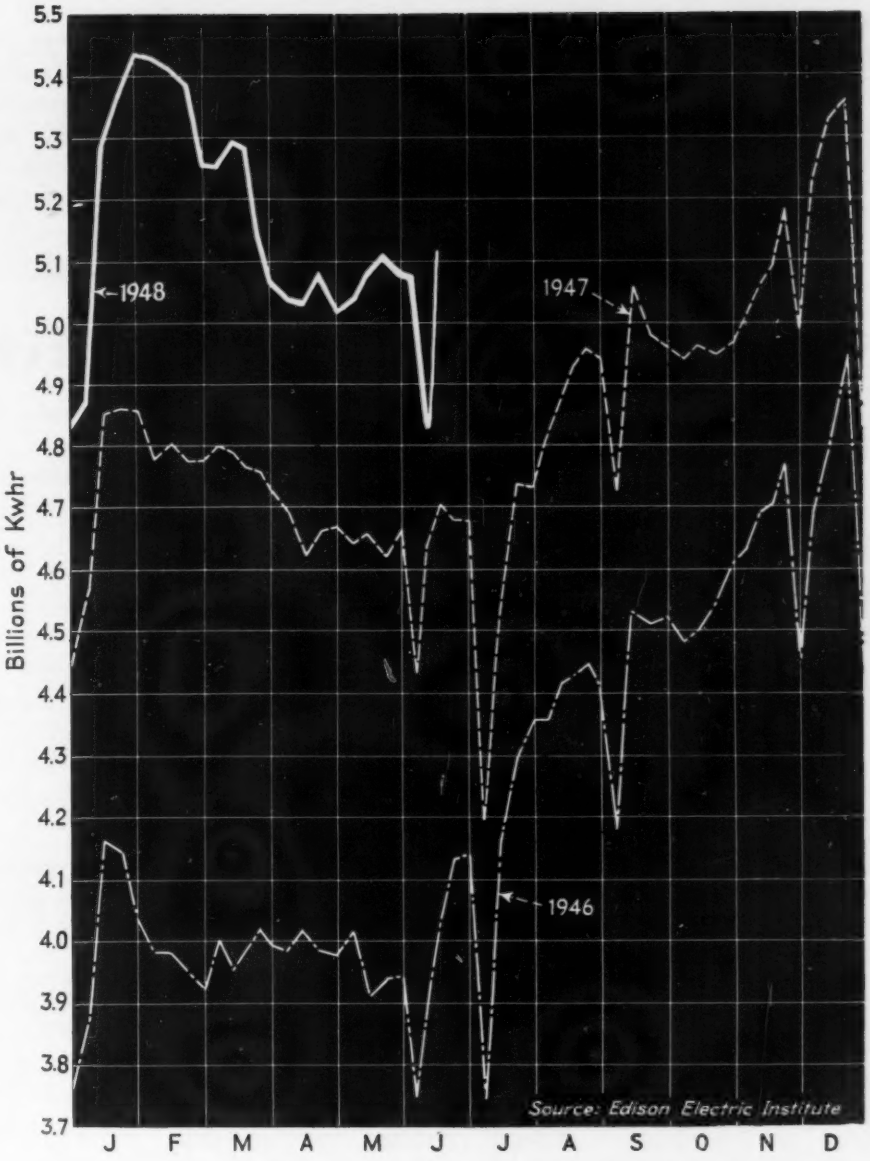
Utility Gives Pay Raise

A pay increase of 15 cents an hour has been granted 1,450 employees of the Portland General Electric Co. The raise followed two and a half months of negotiations between IBEW and the utility. The raise will be retroactive to Mar. 1. The company offer included a waiver of the three-day waiting period for sick benefits. The wage increase will be extended to the utility's unorganized employees, mostly office workers.

•

Joins West Virginia PSC

Charles E. Anderson has become the minority member of the three-man West Virginia Public Service Commission. He is a Republican.



Secession, ERP Solve Money Problems

ARPUT's back from the EEI convention. He never got to hear any speeches, just hung around the press room and read copies. "Money, money, money is all they're talking about," he scoffed. "Trouble with those people—no originality. They should take a tip from the Southern Democrats, get their states to secede. Then what happens? They become foreign countries. And you know what a sucker Washington is for foreign countries. The utilities could get all the dough they want under the Marshall Plan. No problems with stocks, bonds, and debentures. Get a gift from Uncle Sam and the utility business will be on the up and up, just like last week's output."

Other News

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Weekly Output, Millions Kwhr

1948	1947	1946
June 12 5,132	June 14 4,702	June 15 4,030
June 5 4,845	June 7 4,635	June 8 3,920
May 29 5,076	May 31 4,429	June 1 3,741
May 22 5,085	May 24 4,663	May 25 3,942
May 15 5,109	May 17 4,616	May 18 3,939
May 8 5,087	May 10 4,653	May 11 3,911
May 1 5,042	May 3 4,640	May 4 4,012
Apr. 24 5,027	Apr. 26 4,668	Apr. 27 3,977

Percent Change from Previous Year

	June 12	June 5	May 29
New England	+10.7	+ 1.2	+20.5
Mid-Atlantic	+ 7.5	+ 1.6	+15.0
Central Industrial	+10.9	+ 1.7	+15.2
West Central	+13.2	+10.0	+14.3
Southern States	+11.5	+11.9	+15.5
Rocky Mountain	+ 9.0	+ 7.1	+15.7
Pacific Coast	+ 1.6	+ 0.2	+ 9.6
Total United States	+ 9.1	+ 4.5	+14.6

WASHINGTON COMMENT

WILLIAM B. WHICHARD

DON'T LOOK FOR a flood of foreign orders for power equipment on the heels of Congressional approval of European relief funds. Nations being assisted by the Economic Cooperation Administration won't begin buying any capital equipment until the closing months of 1948. Meanwhile, ECA will continue to finance the relief, rather than reconstruction requirements of the program —fuel, food and fibers.

In fact, the Mashall Plan nations still are drawing up their individual reconstruction programs. When these are completed, they will be "cleared" by the new OEEC (organization of European Economic Cooperation), the European coordinating body. The capital equipment lists of the 16 participating countries will then be screened by ECA's roving ambassador, former Commerce Secretary Harriman, before their final review by ECA in Washington. Only then will any participating nation be permitted to place orders for industrial equipment.

And, incidentally, the Marshall Plan countries themselves—not ECA—will order the equipment. Despite some confusion in U. S. industrial quarters over this point, ECA will act only as banker for the aid program. After trimming requirement lists to make them fit the loan funds available and estimates of what the U. S. can afford to export, ECA will simply dole out Marshall Plan dollars. Each of the borrower nations then will have to locate the particular equipment it wants and place the orders with American producers.

There are indications that several European nations will send purchasing missions here, especially to pick up more scarce types of equipment. Several enterprising U. S. industrial firms already have started contacting prospective customers among the 16 nations, sending their own representatives abroad for the purpose.

For a year, at least, the impact of the aid program on the electric power industry, from manufacturers of equipment to the utilities, is almost certain to be slight. Europe wants to produce the bulk of the heavy power equipment it needs in its own factories. Everyone who has had any part in Marshall Plan scheduling in this country has been acutely aware of domestic needs for such facilities. Result has been that Europe does not expect—and the U. S. will not allocate—much in the way of major generating equipment for foreign aid.

There is business—some $95,000,000 of it—for the electrical equipment manufacturers in the first year of the Marshall Plan (July 1, 1948 to June 30, 1949). This is the total of such equipment which the administration has figured we can spare above domestic requirements in that period. But it includes almost everything electrical that is produced here, from batteries and small motors to conductor and generating facilities.

At the same time, Europe plans to produce more than $200,000,000 of electrical equipment for the program in its own plants. That proportion is likely to grow even more topheavy on the European production side if foreign equipment makers can get new and replacement parts and raw materials they need to step up their production.

TECHNICAL TRENDS

ARCHER E. KNOWLTON

Controlroom lighting is an orphan problem neglected by lighting manufacturers, switchboard manufacturers, illumination engineers and even utility commercial men. Power plant designers are desperately trying louvers, plastic skies and lamps inside instruments—all by themselves.

Hydrogen cooling can be enhanced in effectiveness if, as is done by an eastern utility, the pressure is raised gradually from ½ to 15 psi as cooling water temperature goes up and is correspondingly reduced in the Fall months.

Industrial productivity increase is a crying need. When electrical energy is called in to help, the increased production calls for a substantially greater increase in consumption.

Impulse testing of all transformers would be a desirable addition if it could be done cheaply and safely on the production line.

Linear couplers have a distinct advantage over iron-cored current transformers for relay protection in that they are not subject to saturation by d-c transients.

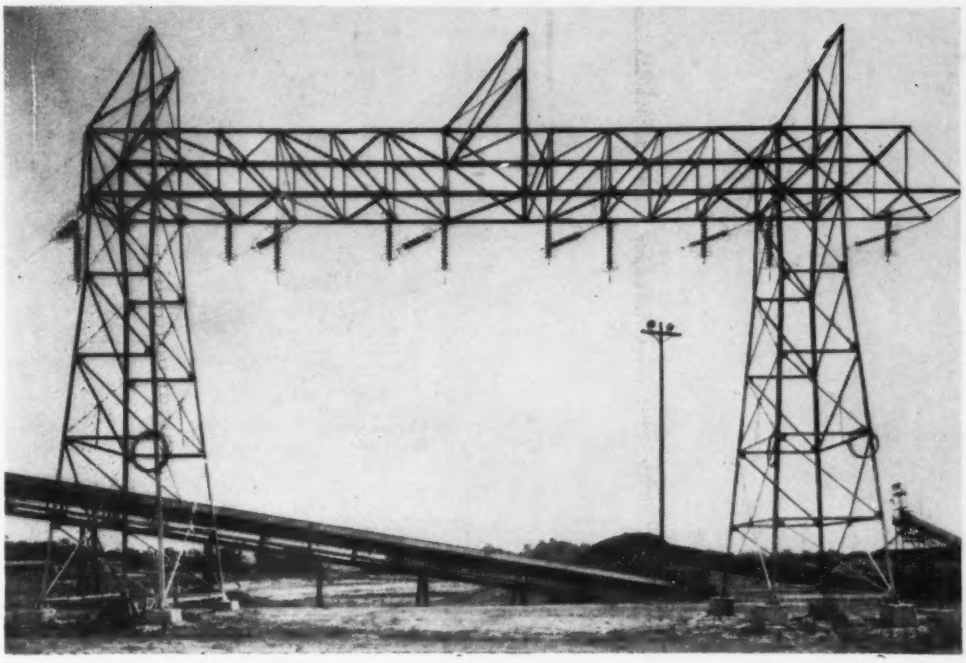
Deionizing time, some 18 cycles, can be circumvented by using the synchronizing effect of the good phase while tripping only the ground-faulted conductor.

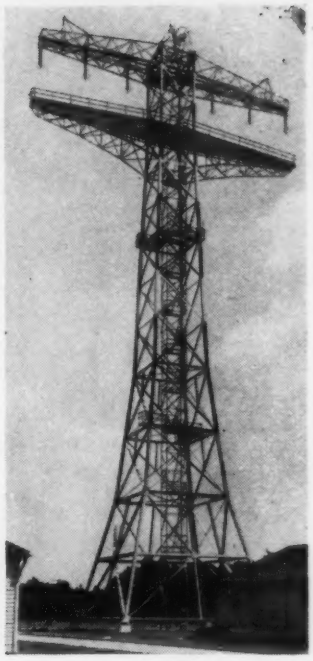
Cable configuration in multiple-bank ducts has much to do with the heat dissipation and circuit carrying capacity. Engineers are asking for more guiding data.

Steel panels with thermal insulation would, if the steel situation permitted, be a handy way to beat the high cost of laying brick walls.

Vertical cyclone furnaces under test will, if expectations are confirmed, save space, simplify boiler design and virtually make slag removal an external operation.

Distribution continuity is not receiving adequate analysis because too many companies feel mistakenly that they are doing better than average.





SOUTH ANCHOR TOWER (No. 2) at left above completes right-angled turn of line before passing to first suspension tower (No. 3) at right on south bank of river. From suspension tower No. 3 conductors cross river to opposite bank

James River Span Requires Varied Tower Designs

Directional reversal in generating plant take-off overcomes handicaps of proximity to switch yard and river bank

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Stone & Webster Engineering Corp
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A TRANSMISSION LINE crossing with reversed direction of take-off circuits solved an important problem for the Virginia Electric & Power Co. The crossing is a 110-kv outlet to the north from the company's Chesterfield power station, east of Richmond. Spanning the James River, it links the plant with existing lines to Richmond and Newport News. Five steel towers are required, with an aggregate weight of about 230 tons. The power plant and three towers are located on the south side of the river, with two towers on the north side.

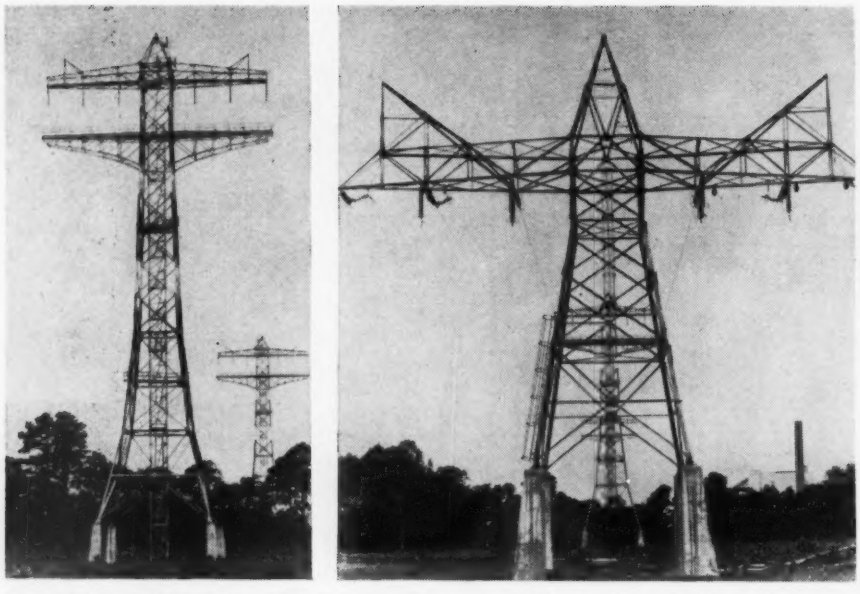
All power outlets from the plant emanate from the south side of the station. Due to congestion in the station yard, towers 1 and 2 are bridge-type 90-deg angle, dead end steel structures. These reverse the direction of the six No. 4/O H. D. copper phase wires and three $\frac{7}{16}$-in. S. M. galvanized steel ground wires forming the transmission set-up, which is supported on the river crossing towers.

Navigation Clearance

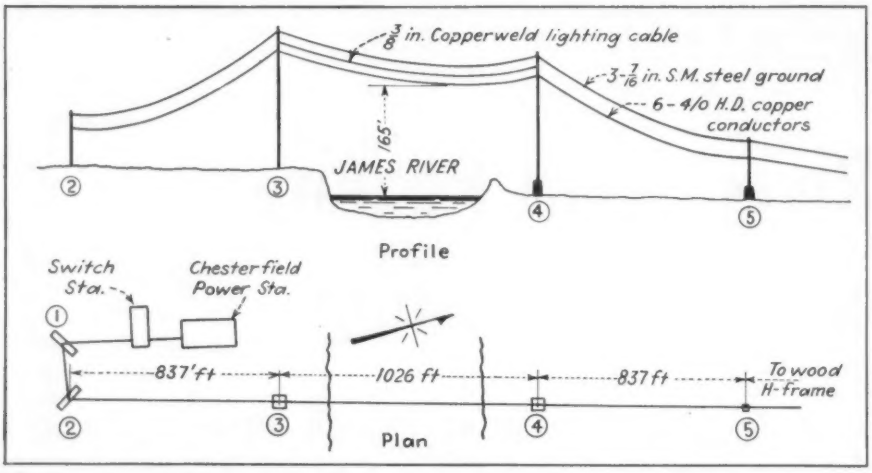
Towers 3 and 4 are the main river crossing steel structures spaced 1,026 ft apart. These are 212-ft high, giving a required minimum navigation cable clearance above mean low water of 165 ft.

Tower 5 is a dead end steel structure 80-ft high, with a single crossarm 80-ft wide. The normal design for this tower would have been to support each power circuit on separate wood pole H-frames. Flood conditions and the accompanying hazards, together with unsatisfactory soil conditions, determined the use of a single steel structure involving only one foundation.

Since the smaller towers adjacent to the main towers are dead-ended structures, it was economical in cost to connect all conductors to the main towers 3 and 4, using suspension type insulators. This was preferable to subjecting them to the full strain of all cables. Such a procedure as this also provided greater ease of access to all insulator assemblies on the main towers.



SECOND SUSPENSION TOWER (No. 4) on north side of river. North anchor tower (No. 5), on north side of river, whence conductors pass to wooden H-frame line supports



ARRANGEMENT OF TOWERS used in 110-kv river crossing

Horizontal configuration of cables was elected between all steel towers. This was due to the unusual ice conditions occurring in the past. With heavy ice formation on cables, the ice is likely to fall off on one span before it is released on the adjacent span of the same cable. This produces a definite longitudinal swing of the main tower insulators and a large and sudden change in cable sag between towers. Since the ice action on adjacent cables is likely to be very different in the above respects, differential ice loadings in adjacent spans and consequent varying sags, might result in cable short-circuits with accompanying vertical configuration.

The main tower design has a parabolic outline of the legs with well-proportioned crossarms above. The main legs consist of rolled column sections which reduce bracing and redundant members to a minimum. These emphasize the lines of the structures and present a pleasing appearance.

Color Scheme

The main towers are painted alternate white and orange bands. They are illuminated at night with flashing beacons. Wires are floodlighted with directional projectors to safeguard air navigation along CAA requirements. Access to various points on the main towers for servicing lights and equipment is by a continuous ladder system. Resting platforms are located about every 16 ft. These are inclosed in a separate cage structure located inside and supported by the main structure. The main upper crossarm supports all cables, beneath which a complete access platform is constructed. Access walkways are also furnished over the conductors. As the three anchor towers, 1, 2 and 5 are of much lesser height than the main towers, they do not need to be lighted. An outside ladder with safety hoops provides the required access.

Foundation Conditions

Foundation conditions for towers 1, 2 and 3 were favorable. Ground level is well above high water. This permitted soil-bearing concrete footings. On the north side of the river the ground level is much lower. Periodic flood conditions occur. Therefore towers 4 and 5 are supported on concrete piers extending about 20 ft above ground to 5 ft above record flood level. The piers are connected on all four sides at ground level by heavy concrete struts. The entire structure is supported on wood piles. Further protection against debris and possible scour is planned by placing wood fenders or rip-rap around the tower piers.

Withstand Double Load

Towers 1, 2 and 5 are designed to withstand at least double the load applied should any or all cables be broken on one side of the structure when each cable is subjected to a tension of 5,000 lb with heavy loading of 0.5-in. radial ice and an 8-lb wind.

Towers 3 and 4 are designed to withstand at least twice the load applied in case any three cables be broken on one side of the structure with the above loading in each of the cables.

The transmission line of which this crossing is a part was designed and constructed by the Stone & Webster Engineering Corp. This firm determined the arrangement, outline, assumed loading and unit stresses for the steel structures of the river crossing.

Bethlehem Steel Co handled the design, shop detailing, fabrication and erection of the steel towers. The entire engineering and construction work of this project was carried out under the supervision of the engineering department of the Virginia Electric & Power Co.

ADVANCED STUDENTS have opportunity to solve intricate problems as aides to utility experts on system operation

Rewinning the Campus:

Power Courses Await Utility Support

Survey shows faculties ready to emphasize 60-cycle curricula: movement hinges on power-minded teachers, power-bent students, and utility stimulus

ARCHER E. KNOWLTON
Senior Associate Editor

POWER UTILITIES can count on the collaboration of the country's technical schools to prepare as many qualified electrical and mechanical graduates as the utilities want. The spirit and the willingness, even eagerness, are there. The facilities are there. But at the moment, the faculties lack the necessary number of qualified and oriented teachers. Nor has the number of students choosing a power industry career recovered to anything like the fraction that it should reach for technical security of the power industry.

What the schools look for—beyond what was pointed out in the November 8 article—are the following:

1—Faculty additions from utility circles as well as from manufacturing circles.

2—Occasional lecturers from utilities to discuss utility technology for the benefit of students and faculties.

3—Assurance to students that there will be attractive jobs at attractive pay and with attractive futures.

4—Encouragement of graduate study for prospective recruits.

5—Opportunities of summer work for students.

6—Opportunities of summer work for faculty members.

7—Opportunities for faculty members to participate to some degree in industry committee activities.

8—Interviewers who are capable of matching the appeal of competitive industries for recruits.

Throughout the responses runs a tone of favorable attitude toward the manifest needs of the power industry. Coupled with it, however, is a mood of helplessness unless the industry shows a desire to supply the deficiencies in the picture. Many of the schools report that a swing back to enrollment in the power courses is in the initial stages. But, again, the rate at which this accelerates depends on the incentives that prompt the students' decisions.

Electronic Competition

That brings up the matter of electronics competition. Admittedly the momentum given to electronic pursuits by the war is still in evidence. But the excitement is tapering off. At the University of Oklahoma, 50 of the 60 in the latest class registered for the power option. In the light of this, the department is planning to

reinstate the advanced courses in distribution, illumination and system stability. Professor Kurtz of Iowa reports a distinct swing to the power option.

But the colleges almost unanimously insist that electronics overshadowed the power courses only in a transitory way. Faculty members, previously intent on teaching basic electrical engineering preparatory for power, communication, or electronics careers have fought the temporary dominance of electronics. They hold that their foundation courses are basic; that the curricula should prepare students equally for either pursuit. Professor Hazen, electrical engineering head at MIT, says many men trained as power engineers readily shift to the microwave field, and the reverse shift could be made with little difficulty if comparable inducements were offered. It has, in fact, begun, but "it impinges more on manufacturers of power equipment than on power utilities". Professors Tompkins of Brown and Young of Delaware both assert they try to encourage students to sign up for power courses; the latter adding that he believes the power field offers excellent opportunities.

Faculty Shortage

One school, unidentified by request, reports that the greatest trouble lies in obtaining competent faculty members to teach power courses. Two months of advertising of a vacancy brought not a single applicant. Dean Schilling says one of the reasons why Montana State has so many staff officers who have had experience with the large electrical manufacturers is the fact that those companies have programs which attract men about to graduate. They are so pleased with those cadet programs that later, as teachers, they can hardly be blamed for influencing their own product to enter manufacturing employment. If the teachers with utility-system experience could be obtained "it would more than repay the utilities" for the efforts or sacrifice. Another item suggested by Dean Schilling is that summer employment should be arranged for engineering teachers.

Several of the university people accuse the utility and manufacturing scouts of advising the students against staying at school for graduate work. No reason for this attitude was imputed. But the assumption is that both groups prefer to "catch the prospect" before he is too specifically engrossed, the preference being to impart the specialized training in the environment of actual practice.

Inference is that this may be justifiable from the selfish standpoint of the utility and the manufacturer but it has two adverse consequences. One, it gives the student the idea that neither industry is willing to pay the price for more penetratively prepared graduates. Two, and far worse, it deprives the professor of enrollments in the graduate classes in which he aspires to utilize the specialized knowledge he has acquired in his prior engineering experience. Few engineers would leave utility positions just to teach undergraduate courses. The undergraduate courses, far and wide, are stated to be fundamental and broad in their objectives. The intensive and specialized courses are saved for the "fifth year" or the graduate school.

This habit of discouraging prospective power industry employees from taking graduate work is cited by Professor Ryder of Iowa State as one of the reasons why electronics has had the ascendency.

Oriented Courses

Many of the schools adhere to fundamental, unspecialized courses for the undergraduate, moving the particularly oriented courses into the graduate years. Many of the catalogues and questionnaire replies reflect courses in transmission engineering, distribution engineering, power system stability, symmetrical components, power-line transients, illumination engineering. Electives for seniors embrace such specific topics as electrical machinery, industrial electronics and comparable courses in the related mechanical engineering curricula.

Even more directly related to training for utility service are such courses as that conducted by Professor Doggett at Penn State. Nine of 52 in the latest graduating class took his course in Electric Public Utilities manifestly designed to impart an understanding of the boundary contacts of the utility engineer. The course discusses the utility art in terms of its differentiating characteristics, franchises, regulation, service standards, rate-making, valuation, depreciation, rate of return, accounting, operating economics, capitalization, regulation. Of course, most institutions present such courses in the school of business administration.

Physical Facilities

Recent additions to laboratory facilties to implement the oriented courses seem not to have been very extensive except in the case of network calculators. These elaborate instruments for system analysis have been installed at MIT, Purdue, Armour Research Foundation, University of Kansas (EW Jan 5, 1946, p 53) and more recently Georgia Tech. Iowa State in the questionnaire lists an a-c network analyzer and Ohio State a calculating machine laboratory. Other items mentioned by other schools are high-voltage and high-frequency test and research facilities, and surge generators.

Faculty Specialists

All but three of the schools listed have faculty members who devote major time to the basic and oriented courses which can be counted as preparing students more or less specifically for power system employment. This in no way contradicts the firm intention of most of the schools to focus almost exclusively on fundamentals. It seems to mean that practically every institution has one or more faculty members who will form the nucleus of any expanded group dedicated primarily to the idea that megacycles and microwaves have their place but that the 0-to-10,000 cycle range (embracing the dominant 60 cycles) has a permanent and pervading future.

Out of the 38 institutions, there were only five in which no faculty members had served in some capacity with power utilities at some point in their career. In only ten had none of the faculty members engaged in consulting for power companies since they entered the teaching field.

Those sound like goodly percentages. But if the student enrolled in power-tinged courses increase, there will have to be a faculty expansion in the same direction.

The schools reporting the largest percentage of recent graduates taking jobs with power companies were

Illinois Institute of Technology, Louisiana Polytechnic and Santa Clara University (each 50%) and Oklahoma A&M (55%). Others ranged from 40% down to none with an overall average slightly above 25%. A much larger fraction signs up with electrical manufacturers and there is no way of knowing how many of the latter group are headed for electronic pursuits and how many for power pursuits. These percentages seem generous and no cause for worry by the electric utilities. But it is probably true that the other 100-odd schools would reflect a far lower average. At least they did not choose to respond to the queries.

Cooperative Courses

Cooperative courses are reported by University of Cincinnati (which has had them for 42 years with both utilities and electrical manufacturers), Drexel Institute (4 utilities and 9 manufacturers), Penn State, Georgia Tech, Purdue (in connection with the network calculator), University of Michigan (2 utilities), California Institute of Technology (old-time employment), Illinois Institute of Technology (graduate students in summer).

The only school reporting scholarships and fellowships supported by power companies is the University of Washington which has 3 scholarships. Several have such incentives set up by the electrical manufacturers, namely Washington University (10) Illinois Institute (2), Johns Hopkins, University of Michigan, University of Illinois (4), Georgia Tech, California Institute (2), Penn State (2), Drexel.

What Can Utilities Do?

Practically unanimous is the assertion by the pedagogs that the salaries offered by utilities to attract graduates are too low to appeal in competition with other industries. They reported this to President Lindseth of Cleveland Electric Illuminating Co when he drafted his EEI speech a year ago. They are still saying it. Some professors add that the 15-year graduate with 8-10 years utility experience does not go back to a $3,000 job after the war when electronics offers him double that figure. As Professor Hazen of MIT puts it "the utilities have the responsibility for shifting the attitude which results largely from too many engineers finding the business less attractive. Interest on the part of the schools will be quite responsive."

Other Comments

1—Demonstrate that steady advancement is assured for capable men.

2—Show that utility executives are forward-looking and not tradition-bound.

3—Guarantee that utility department heads encourage the development of their juniors.

4—Interviewers must be capable of doing an enthusiatic selling job.

5—They must be capable of explaining the correlative benefits of employment with the utility.

6—Stop using college graduates as oilers and to "dig post-holes just to get the feel of things". Don't keep them in the drafting room too long.

7—Provide real technical assignments to hold the interest of the engineering graduate and prevent him from "going to seed".

8—Take on more undergraduates for summer work.

9—Show that the training program for recruits has positive progress and consequences. Feeling is that promotion is slow and uncertain.

10—Don't expect graduates to join a union, particularly temporarily, just to get a future professional job.

11—Give reassurance that students with advanced graduate training will be given opportunity to apply their enlarged talents.

12—Correct the impression that utilities are "farming out" so much research, design, construction and supervised operation that they really do not want engineers anyhow.

Only four faculty members of the answering schools participate in non-technical consulting work for power companies. In 25 schools, none did so. In only five schools did electric companies sponsor non-technical research. Fourteen schools indicated they could undertake such work and 16 would welcome it.

EDUCATORS RESPOND

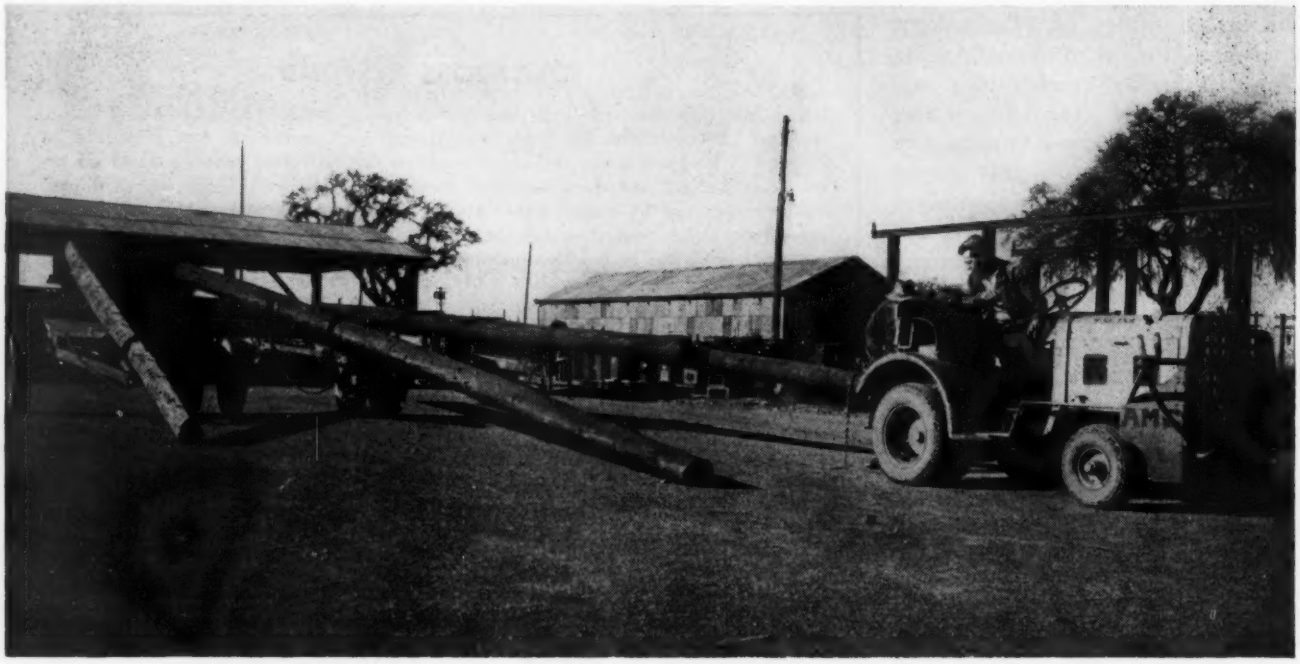
REACTION to the article in the November 8, 1947 ELECTRICAL WORLD entitled "Prerequisites to Successful Recruiting" indicated that it would be helpful to find out more specifically where the technical schools stand on the question. Letters and questionnaires went to 138 electrical engineering departments accredited by Engineers Council for Professional Development. Replies came from the schools listed below.

Questionnairing is hardly more satisfactory for discovering what is really delivered in the classroom than studying a college catalogue. Fortunately most of the deans and head professors wrote amplifying letters. The article represents a synthesis of their candid and constructive comments.

Massachusetts Institute of Technology
Drexel Institute of Technology
The Ohio State University
University of Santa Clara
University of Washington
University of Maine
Brown University
Bucknell University
Iowa State College
The University of Oklahoma
Montana State College
The Pennsylvania State College
University of Connecticut
Rhode Island State College
California Institute of Technology
Georgia School of Technology
University of Delaware
Oklahoma A&M College
University of Cincinnati
New York University
University of South Carolina
The State University of Iowa
University of Illinois
University of Texas
Tulane University
Louisiana Polytechnic Institute
University of North Carolina
Purdue University
Washington University
University of Michigan
Yale University
The Johns Hopkins University
The State College of Washington
University of California
Illinois Institute of Technology

Business Schools

University of Minnesota
Harvard University
Stanford University



INDUSTRIAL TRACTOR with 4,000-lb draw-bar pull spots loaded pole trailers near cross arm shed ready for subsequent pickup by line trucks. It is also used for moving loaded railroad gondolas from one pole rack to another during unloading operations

Improved Materials Handling

Time saved in assembling and loading construction materials on line trucks reduces waiting time of line crews—Mechanized handling of poles, wire and transformers increase flexibility, efficiency of utility warehouse operations — War-surplus equipment used

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Sacramento Municipal Utility District
Sacramento, Cal

INVESTMENT in equipment to speed up the handling of construction materials has proven exceptionally profitable for the Sacramento (Cal) Municipal Utility District. It has boosted the efficiency of stores operations and trimmed expensive minutes from the time required to equip construction crews with material for a field job. Thus former "dead" crew time is now being applied in the field to reduce the backlog of work that accumulated on the system due to wartime shortages of manpower and materials.

Equipment selected is shown in action in the accompanying pictures. Much of it was war-surplus and was purchased at a considerable cost saving.

One of the major time savings was made in pole handling by the use of mobile cranes, improved storage racks, pole trailers and an industrial trailer for spotting and hauling pole trailers in the yard.

Operations have been made more flexible and efficient by using a war-surplus gas-powered mobile crane to transfer poles. It has a 36-ft boom mounted on an 8-wheel chassis. Maximum capacity is 5 tons and it can handle 3 tons at full boom. This crane is also used to handle heavy transformers and cable reels.

However, the crane may be engaged unloading poles when it is needed to unload wire from a gondola or to load pole trailers. Also there are occasions when use of a large crane is impractical. To meet these situations a 2-5 ton "hoist and carry" type crane was purchased, also from war surplus. It has an adjustable boom on a 116 in. wheelbase. Its front wheel drive and dual caster wheels in the rear make it maneuverable.

Pole-storage racks were built with street-car rails mounted on concrete piers 18 in. above ground that had been poisoned to inhibit weed and grass growths. Poles are stored on these racks at right angles to the railroad tracks because analysis showed that less crane movement was required than otherwise.

Poles are loaded on two-wheel trailers during the day so that line trucks can hook on and draw them away without delay the next morning. Older trailers were awkward and ill balanced. They were replaced by several surplus two-wheel 2½ ton utility

5-TON POWER CRANE with revolving 36-ft boom on 8-wheel chassis and 120 in wheel base has many store-yard uses

HOIST AND CARRY jobs for handling many kinds of materials, like this 8,000-lb reel of cable, are done with this 2-5 ton crane

Cuts Crew Dead Time

trailers with a 56 x 68 in. channel iron open bed and telescoping tongue.

Loaded pole trailers are left at the rack if not in the way. Otherwise they are hauled to an open-paved space near the crossarm storage bed and the yard exit gate. This in-yard hauling is done with an 8,000-lb industrial tractor with a draw-bar-pull of about 4,000 lb.

One of the most valuable pieces of equipment used is a gas-electric 4,000-lb fork-lift truck with 108 in. lift and solid tires.

A number of wooden pallets in two sizes, 24 x 48 and 48 x 48, have been provided. These are loaded during the day with transformers, wire, hardware and small materials in tote boxes by warehousemen from job material orders.

Pallets are not big enough, of course, to hold supplies for large extension jobs that require a great deal of material. If they are loaded on a line truck the truck must be practically unloaded at the site before the job can be started.

To solve this problem a 2½ ton M-5 bomb trailer with a 68 x 135 in. platform body was acquired and modified for utility use.

They have been very satisfactory on large jobs since all materials can be hauled on them leaving the truck free for the use of men and work equipment. (EW, Mar 27, 1948, p 107) These four-wheel trailers have also been useful in hauling transformer banks to the job. They will handle three 50-kva transformers. Since these are usually transformers mounted on a pole-top platform it is a simple matter to spot the trailers for ready hoisting.

WAR-SURPLUS TRAILERS have been modified for utility use as pole dollies. Telescoping tongue was removed and trailer counterbalanced for easy one-man handling. Wood floor in trailer permits carrying materials or rocks to job

FORK LIFT TRUCK transfers pallet loaded with day's supply of materials onto line truck. Material is assembled on pallet in daytime, loaded on truck when it comes in at night. Truck is also used to unload material from freight cars

The Case for the Thermal Meter

An evaluation of factors contributing to growing popularity of thermal meters shows that their reliable low-cost demand metering has extended range to which demand metering can be applied economically

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THERMAL METERS have grown in use in the past few years. In seeking a reason for this sudden interest, one might surmise that years of research and development have improved thermal devices to the point that they are of increased value.

However, unbiased analysis shows that improvements were not the primary cause of this increased popularity. Although the combination watthour meter and thermal watt demand meter in the standard size cover is a significant advance its development, if anything, was the result rather than the cause of rising interest in thermal meters.

Present popularity of thermal meters springs from the reliable low-cost demand metering that they provide. This, in turn, has extended the range to which demand metering may be economically applied. Moreover, the present trend, if anything, gives indications of still further accenting the swing to thermal meters. This naturally will lead to further improvements in the thermal meter.

To support this conclusion it must be evident that thermal meters, if they are to invade the field of existing apparatus, must be superior in one or more of the following factors:

1. Initial Cost
2. Maintenance
3. Useful Life
4. Reliability
5. Accuracy
6. Performance
7. Versatility
8. Testing

1. Initial Cost—The single phase combination watthour meter and thermal watt-demand meter has a small initial cost advantage. Separate single-phase thermals are at a slight disadvantage with respect to mechanical attachments.

As far as polyphase meters are concerned the initial cost of separate meters is somewhat more than for demand attachments. The combination polyphase meters are comparable to a polyphase meter with demand attachments.

When the field of kva metering is considered, it must be remembered that mechanical kva meters give a good deal more information than any type of thermal meter. The RI recording kva meter, for example, gives kilowatthours, kilovarhours, recorded kilowatt demand, recorded kva demand, and instantaneous power factor. The separate displaced-voltage kva meter gives only kva demand. The combination watthour meter and ammeter gives kwhr and kva demand. While this information is not as complete as that offered by mechanical types, it is often all that is required. The initial expense of the thermal types is only a fraction of that of the mechanical meters.

2. Maintenance—Here the thermal meter takes a long lead over the field. Reported experience shows that the maintenance of thermal meters has been remarkably low. It is usually considered that the testing period is the same as the watthour meter.

The fundamental reason is that the only moving parts are the bimetal springs and shaft, and the maximum demand pointer. It is almost axiomatic that the maintenance of demand devices varies directly with the number of moving mechanisms. This is only one of the factors in choosing the type of metering, but it is generally considered so important that it will outweigh most of the other disadvantages.

There are no high-speed shafts, clutch mechanisms, motors or cam arrangements. In short, the parts of mechanical devices which require maintenance are not present.

3. Useful Life—Here again the thermal meter has an edge over its competitors. While it is still too early to speak from experience on the types recently introduced, every indication points toward a longer life than is attainable by mechanical devices. Again, the simplicity of the thermal meter is its main asset. The parts that usually wear out do not exist.

4. Reliability—Although reliability is usually related to maintenance, this is not necessarily the case. The fundamental simplicity of the unit is again the prime factor in its reliability. There is no clutch to stick, no cam to wear, no motor to stop, no shaft to wear or gall.

5. Accuracy—Finally, we come to a factor in which the thermal meter does not excel all others. Mechanical devices can be built to very good accuracies. Bimetal springs, heaters and housings manifestly do not have the same order of accuracy as gears. Then, too, there are two springs opposing each other. They can never be 100 percent identical in their characteristics. Thus, while the scale distribution of a thermal meter may be correct on the average, it is not unusual for one meter to read 49½ or even 49 while the other reads 51 for a half scale load which should normally read 50.

This is not intended to imply that the thermal meter is inaccurate, only that it is not a precise device. It should be understood that the sacrifice is of small degree. Resulting accuracy is still well within reasonable limits. Over a long period it is quite likely that the thermal meter may prove equal or better than other types of devices, even in accuracy, because of the other factors listed.

The question is often asked by meter men: "How does the thermal element affect the watthour meter performance when the potential coil of the watthour meter is used as a po-

* Footnote: Based on a paper presented by the author before the Northeastern Meterman's Association

tential transformer for the thermal meter?"

The answer is that it reduces the total losses of the meter considerably, since both copper and iron losses are less than those that exist if a separate potential transformer were used. More important, it reduces the space required. Effect on watthour meter performance is negligible since the line current enters the secondary at the midtap. The ampere turns in each half of the coil are, therefore, equal and opposing and cause no flux. The circulating current flowing in the secondary is balanced by an equal and opposite current in the primary.

6. Versatility—The list of types of thermal meters shows that they can be used to advantage for practically all types of metering. Separate or combined; single or polyphase; kilowatt, kva, kilovar or ampere demand —the thermal can be applied to all.

In another sense the thermal is less versatile than its competitors. A universal register can be removed from a three-phase, three-wire meter and transferred to a three-phase, four-wire meter. The capacities of the meters make no difference to the register since the multiplier will reflect the change completely. The thermal meter, on the other hand, is not at all versatile in this sense. This tends to be a minor factor in an expanding field such as the utility industry, in general, and the field of demand metering in particular.

7. Performance—Response of a thermal meter is substantially exponential. Its time interval is arbitrarily defined, at present, as the time required to reach 90% of final indication under a constant, suddenly applied load. It was selected because it gives close agreement with the demand of most loads as measured by a block interval device of the same interval.

The time interval of a thermal meter is governed primarily by the size, shape, density and specific heat and thermal conductivity of the heater boxes. Where the heaters are located with respect to springs, and conduction between the springs through mounting, leads and box, also have a pronounced effect. These factors are not as exact as a synchronous motor in determining time interval. It is customary, therefore, to design for a slightly longer than nominal interval to keep variations from shortening the interval and penalizing the customer.

The possibility of peak splitting by block interval device is well known and need not be elaborated. That a thermal meter will not split peaks is often cited as a major advantage. However, this is certainly not acompelling reason to influence the use of thermal meters rather than block interval devices. Actual comparison of readings of the two types on the same load show little difference in most instances. This is not intended to discredit the principle of the logarithmic average, but to place it in its proper perspective.

A similar claim is that the exponential response is more nearly a duplicate of the heating characteristics of the apparatus which must be provided to supply the load—transformers, generators, etc., since the temperature rise of such equipment is also substantially exponential. While this is true, the time interval of such equipment is in general a great deal longer than that of the meters. Also the concordance of different types of demand meters illustrates that this factor is immaterial. If two devices indicate the same maximum demand, the rate of rise is of no consequence.

8. Testing—Fundamentally a thermal meter of a given interval takes longer to test than a block interval device of the same interval. Moreover, mechanical devices can be driven by a synchronous motor with no question as to the proper indication. Block interval devices can be conveniently tested in the field.

These points can be analyzed as follows: (1) the increased length of test time does not mean that more man-hours are required, since constant attendance is unnecessary. It does mean increased test facilities to some extent. (2) The thermal equivalent of the synchronous motor drive is an electronic load controller which holds the load constant regardless of voltage fluctuations.

(3) Field testing in general seems to be giving way to laboratory testing as a more efficient method.

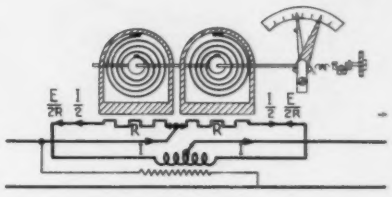
The other alternative is the use of a standard with the same characteristics as the meters being tested. This is analogous to the portable standard method of checking watthour meters.

THERMAL METER FUNDAMENTALS

PRINCIPLE of the thermal meter, developed in 1913, derived demand registration from the differential action of opposed kerosene-filled bellows heated and expanded by resistance heater elements. Difference in deflection torque was proportional to watt load. Later, heated bimetallic springs replaced the bellows scheme.

In understanding the thermal meter, consider first the no load condition. Voltage is applied to the heaters but no line current is flowing. Both heaters become equally hot. Since the two bimetal springs are oppositely wound, the pointer remains at zero.

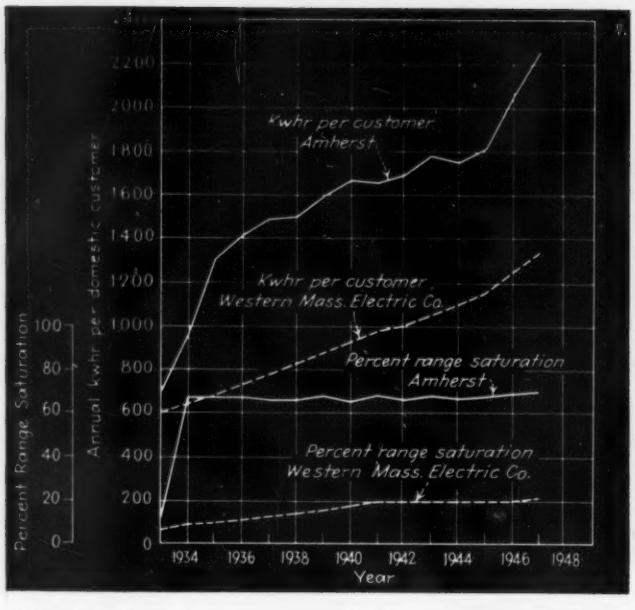
As line current flows, current in one heater increases while that in the other decreases. Each of these conditions causes the pointer to move up scale. As load increases a point is reached where current in front heater is reduced to zero. This is the most efficient operating point since there is no heat opposing the pointer deflection. It occurs at unity power factor when line current is twice the circulating current caused by the potential transformer. It is one of the important design considerations in attaining minimum losses and temperature rise.



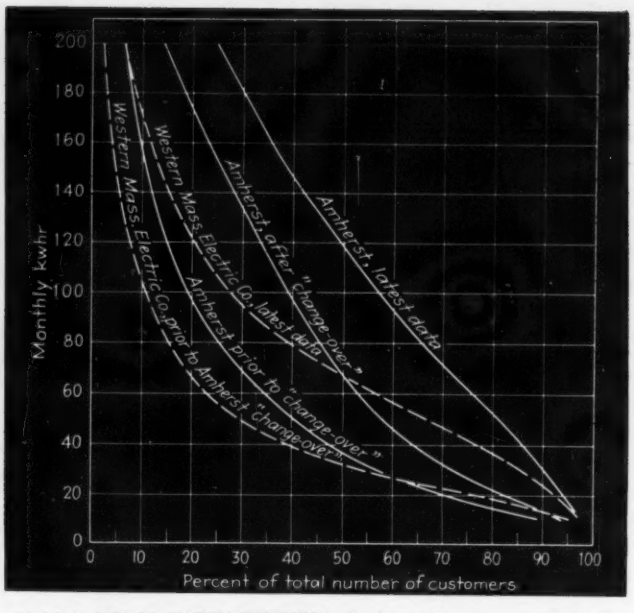
Thermal Demand Meter

In addition to providing a deflection proportional to power, the opposing spring arrangement minimizes errors caused by ambient temperature changes. If only one bimetal spring were used it would deflect regardless of whether temperature change was caused by load or by a rise in ambient temperature. The fact that the two springs oppose each other eliminates this condition almost entirely.

The thermal meter we have been discussing is a basic one. Many circuit variations are possible. Current transformers can be used; more than two heaters can be and usually are used; a bridge circuit of four heaters may be used to eliminate the center tap on the secondary.


Kwhr per customer Amherst
Kwhr per customer Western Mass. Electric Co.
Percent range saturation Amherst
Percent range saturation Western Mass. Electric Co.
Annual kwhr per domestic customer
Percent Range Saturation
Year

COMPARISON of energy consumption per customer with electric range saturation at Amherst and on Western Massachusetts system


Western Mass. Electric Co. prior to Amherst "change-over"
Amherst prior to "change-over"
Western Mass. Electric Co. latest data
Amherst after "change-over"
Amherst, latest data
Monthly kwhr
Percent of total number of customers

CUMULATIVE DISTRIBUTION of domestic customers before and after Amherst changeover from gas to electric ranges

Electric Ranges Stimulate Other Uses

Complete replacement of gas ranges at Amherst, Mass accelerates growth of domestic energy consumption

LESTER W FRANK
Rate Engineer
Western Massachusetts Electric Co
Springfield

WHEN GAS COOKING is abandoned in a community and sales resistance is swept away by substitution of free electric ranges, much statistical data becomes suddenly available. Instead of having to "project" into the future, the future is evident.

Such was the case in Amherst, Mass. In 1934, the Western Massachusetts Electric Co and the Amherst Gas Co served the 6,400 people in the town. Both companies were subsidiaries of the Western Massachusetts Companies. Amherst is principally a residential community with only minor industrial business. Most of the population is supported by Amherst College and the University of Massachusetts. Also the town has a considerable colony of artists, writers, and retired professional people. Outside the village is a farming community.

Even before 1934 it was apparent that the gas business was declining rapidly. Large gas users were turning to electric ranges and many smaller customers were changing to range oil burners. The gas company saw no way of overcoming this competition and increasing the gas business to where existing high gas rates could be reduced. No attempt was made to retard the progress of electric cooking in the gas area. Such a "protective" measure would most certainly have caused many customers to purchase oil burners or bottled gas ranges. The business would have been lost to both the gas and electric companies. Furthermore, many gas customers had other means of cooking and were using gas simply as an auxiliary.

It was decided to abandon the gas company. Thus in 1934 one competitor of electric service was removed by abandonment. The other competitor, oil, was overcome in large part by the superiority of electric service. In the abandonment, the gas company furnished electric equipment to replace existing gas equipment without charge. Conversion was started in the spring of 1934 and was completed by that November. Average cost to the gas company for the replacement electric ranges was approximately $60 each in carload lots. Equitable arrangements let any customer secure better quality electric equipment than his gas equipment allowed.

Out of 1,544 total customers, 881 converted from gas to electricity. After conversion, the average annual revenue of all domestic electric users had increased from $46 in 1933 to $60 in 1935. Translated to the present day-rate schedule the bills were $38 "before" and $52 "after" for the annual kwhr of 699 and 1,306 respectively. Most of the increase reflects the change from gas to electric cooking.

But the most important lesson lies in the performance since 1935. After the changeover, electric range saturation in the community was 67.5%. Apparently this was just about the limit of saturation, because by the

TABLE I—Growth in Kwhr per Domestic Customer Western Massachusetts Electric Co.

Community	1947 Kwhr Per Customer	1947 Ranking Position	1947–1937 Growth In Kwhr Per Customer	1947–1937 Ranking Position
Longmeadow	2,613	#1	897	#2
Amherst	2,244	2	762	4
Shelburne	2,082	3	982	1
Deerfield	1,750	4	747	5
Northfield	1,715	5	623	9
Agawam	1,666	6	873	3
Southwick	1,616	7	723	6
Lee	1,526	8	677	8
U. S. Average	1,438	.....	633	.....
Dalton	1,369	9	574	11
West Springfield	1,355	10	566	13
West. Mass. Elec. Co. System	1,334	.....	556	.....
Greenfield	1,314	11	526	14
Ludlow	1,296	12	722	7
Hadley	1,283	13	605	10
Springfield	1,244	14	503	15
Buckland	1,220	15	570	12
Pittsfield	1,168	16	430	18
Hatfield	1,110	17	473	16
Easthampton	980	18	452	17
Turner Falls	945	19	395	19

TABLE II—Increase in Electric Range Saturation Western Massachusetts Electric Co.

Community	Increase In Range Saturation 1947—1937 Percent	Rank	1947 Range Saturation Percent	Rank
Agawam	20.8%	#1	32.6%	#6
Longmeadow	17.5	2	49.6	3
Shelburne	16.6	3	49.8	2
Greenfield	14.7	4	30.6	7
Dalton	13.9	5	22.0	10
Lee	12.5	6	23.4	9
Ludlow	12.2	7	19.9	11
Pittsfield	11.8	8	19.1	12
Deerfield	10.1	9	40.3	4
Northfield	9.9	10	33.3	5
Southwick	9.7	11	30.3	8
West. Mass. Elec. Co. System	8.6	.....	21.3	.....
Springfield	7.8	12	16.0	15
West Springfield	7.6	13	18.2	14
Buckland	6.6	14	18.9	13
Turners Falls	6.3	15	13.5	17
Hadley	5.9	16	13.2	19
Easthampton	5.9	16	13.4	18
Amherst	3.3	17	70.1	1
Hatfield	2.6	18	15.8	16

start of 1948, only 70.1% of the Amherst customers were using electric ranges. Yet, with practically static range saturation during the 12 year period 1935-1947, sales to domestic electric users in Amherst increased to a much greater degree than in other towns where electric ranges were being added to the lines at a substantial rate. Comparative data have been placed on the basis of 1937 through 1947, (Table I) because figures are lacking prior to 1937 for many of the communities under review. Range saturation in Amherst had slid off slightly to 66.8% at the end of 1937. In analyzing the available data, communities in excess of approximately 500 customers were taken, a total of 19. In 1947, the average use per domestic customer in the United States was exceeded by 8 of the communities listed.

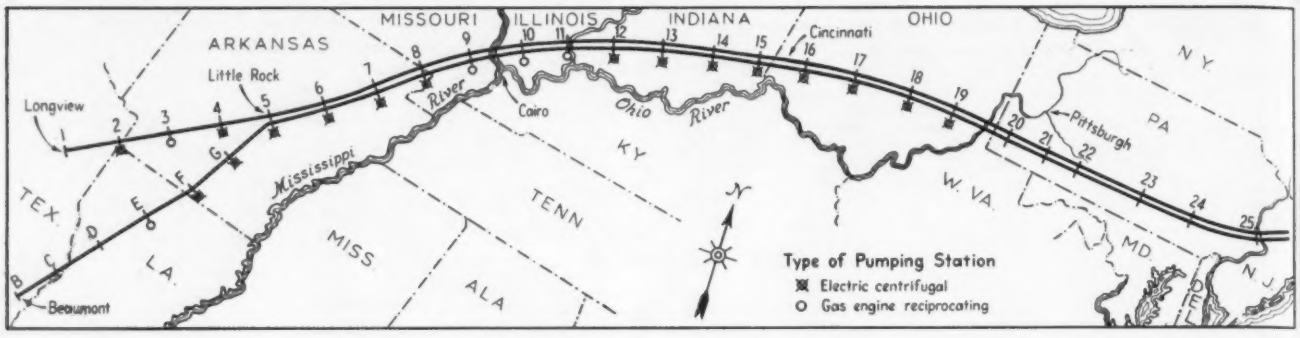
Longmeadow, suburban to the City of Springfield, with a 49.6% range saturation, actually exceeds Amherst's average kwhr use by 16% even though Amherst has a range saturation of 70.1%. The higher per capita wealth of Longmeadow presumably is the cause. Shelburne follows Amherst at an average use difference of only 13 kwhr per month and its range saturation is only 40.8%. Shelburne's high use is ascribed to range saturation, large dairy and poultry farms. Let us shuffle these towns and rank them with respect to range saturation (Table II).

Range saturation increased in Amherst only 3.3% in the 10-year, yet Table I shows Amherst among the leaders in growth in kwhr per customer. Range saturation for the company increased from 12.7% to 21.3% during the period but company growth in kwhr per customer lagged Amherst by a considerable margin. Superficially, it may be considered that average use per customer and its increase are in direct ratio to range saturation and its increase. But is this true?

The data show that, while increase in use results from increase in range saturation, there are other reasons having market effect, such as refrigerator saturation, farm use, and wealth of the community. Amherst range saturation increased only 3.3% in 10 years and its rank of increase in Table II #17. Yet the Amherst increase in kwhr ranks within the first quarter (Table I). It is evident from the data that existing high customer use is not a deterrent to continuing kwhr growth and that with present day appliances use per customer today is far below the ultimate. There is another side to the picture. Looking at the growths over the period and considering the tremendous increases in range saturation in some of the communities in comparison with Amherst's 3.3%, the increases in use in some of the other communities seem small in relation to their increases in range saturation.

The immediate effect of the Amherst change-over in 1934 on growth in customer use was to increase the proportion of customers using over 200 kwhr monthly from 5.4% to 19.9%. The latest figure for Amherst is 25.1%, exceeded by only one other community. The small use customer—one using less than 50 kwhr monthly—was immediately reduced in ratio from 60% to 35%, and is now only slightly above 18%. Prior to the change-over in Amherst in 1934, the average revenue per customer amounted to $45.79. At today's prices of electricity this would have been $37.50. The increase in use resulting from the addition of ranges would have increased this revenue at present rates, to $50.50. In 1947 the average use resulted in a bill of $79.30. Stated another way, while the range load immediately added $14.00 to the average bill, since 1935 we have gained an additional $27.80 per family unit, which gain represents the use of all appliances.

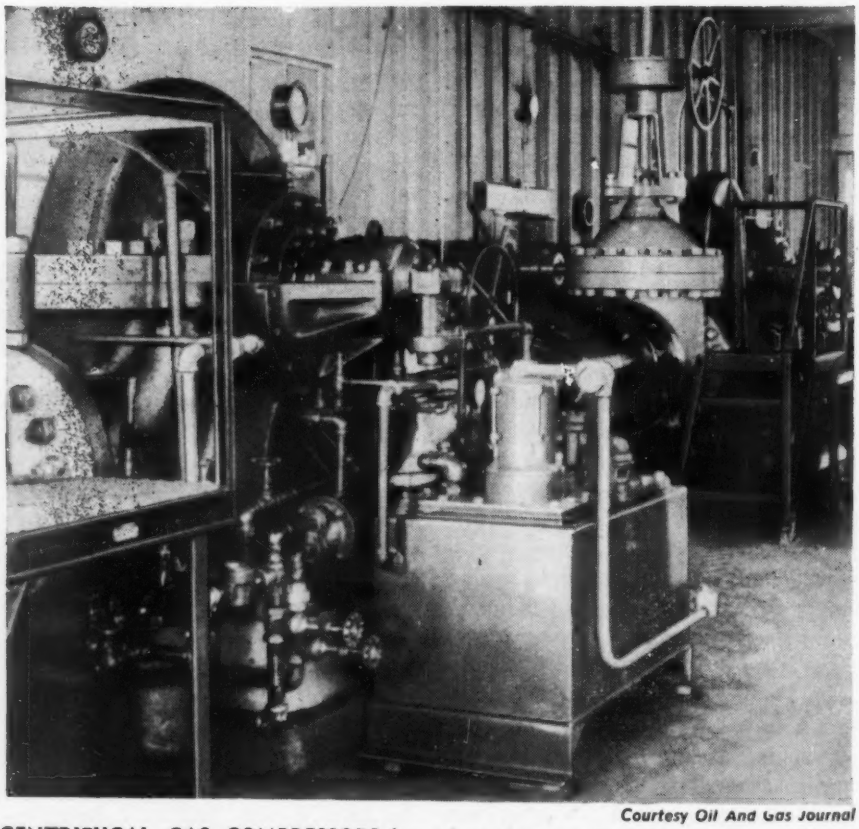
What has been the effect of this load on the substation? From 1933 to 1935 the substation peak demand increased from 1,050 to 1,500 kw. We do not know how much of this increase resulted from the range change-over. But it may be assumed that for the 881 domestic ranges added to the lines the average per range increase in substation peak was less than 0.5 kw, because a portion of the increase in demand must be assigned to new commercial cooking added at that time. Load factor has increased only slightly. In 1933 it was 33.2%, it increased to 34.7%, and in 1947 was 36.1%.



16 STATIONS with electric motors totalling 120,000 hp will drive centrifugal compressors for transmitting natural gas through the system

Converted "Big Inch" Pioneers Motorized Centrifugals

Motor driven centrifugals pump gas at 750 psi through converted Big Inch lines. Use of original equipment, suitable operating techniques, and economic analysis involved in changeover from liquid to gas



Courtesy Oil And Gas Journal

CENTRIFUGAL GAS COMPRESSORS have about the same dimensions as the centrifugal pumps they replaced

W. H. STUEVE*
Manager, Industrial Development Dept
Oklahoma Gas and Electric Company

THE NEWLY CONVERTED "Big Inch" system is making the first use of motor driven centrifugal compressors for high pressure transmission of natural gas. Hitherto for such applications gas engine reciprocating compressors have been used.

This use of electric centrifugal compressors is not only technically significant but opens up an entirely new field for power sales. When operated under economic design conditions, gas lines usually deliver only about one-sixth the heating units as when the same lines are used for oil. Thus, it will cost about as much to transport 1,000 cu ft of natural gas as a single barrel of oil. When the system-changeover is completed, the system will have 120,000 hp installed in 16 stations and utilities serving the system will receive about $6 million in annual revenue.

In the original "Big Inch" system

*Former Chief Electrical Engineer, War Emergency Pipelines, Inc, during 1942-43.

centrifugal pumps transmitted the two different types of liquid through the two separate pipe lines. At each station site, the pumping stations for each line were 500 ft apart. As shown in the tabulation, each station for the 24-in line used three 1,500 hp, 1,780 rpm motors. Each station for the 20-in line used three 1,250-hp, 3,560 rpm motors.

1,250-Hp Motors Kept

For change over to gas transmission, the two pipe lines are manifolded together. All of the 1,250 hp 3,560 rpm motors were used. They: (1) Matched the operating speed of the newly developed centrifugal compressor and (2) suited the economic working pressure and desired capacity of the gas line. The 1,500 hp. 1,780 rpm motors were not used.

Outwardly, the centrifugal gas compressors are very similar to the centrifugal pumps that they replaced. Dimensions are almost the same. The center line of the shaft matched exactly. They were installed by merely unflanging the pumps and flanging in the compressors.

At each station primary electric power is stepped down to 2,400 v by a 3,750 kva, 3-phase, transformer. No changes were required in switchgear. The equipment for the original 1,500 hp motors is more than ample for the 1,250 hp motors that replaced them.

In the "Big Inch" gas system, 66 of the motors are equipped with full voltage starting and 18 use reduced voltage starting. In general, when the 1,250-hp motors are started across-the-line with the discharge gate value closed they reach full speed in 8 sec. Starting current inrush is about 450% running current. On reduced-voltage starters, motors are started on the 65% taps and current inrush is 220%.

By utilizing both pipes, approximately 500 million cfd can be delivered with all stations in operation and each using 8,000 bhp. Since the total rating of the six motors at each site is only 7,500 hp, there is a slight overload. This is not considered harmful. The discharge pressure is 750 psig, the same as when liquids were being pumped.

There is little difference between operating a gas pipe line using motor-driven centrifugal compressors and a liquid pipe using motor-driven centrifugal pumps. The gas is delivered to the first station from the field at an initial pressure of 750 psig.

In pumping gas, the suction pressure on the next station is kept relatively high so that relatively low compression ratios are maintained. When pumping liquids, the suction pressure at the next station is lowered to a value that will insure enough filling of the pumps to prevent cavitation.

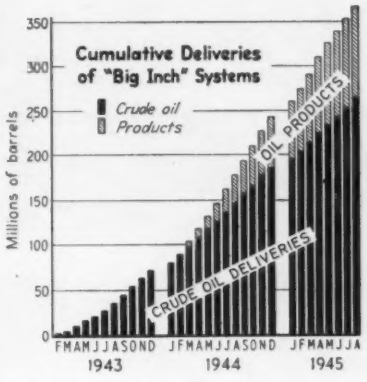
For other than the design gas capacity, one of the three motors in each station can be shut down. This raises the suction pressure; and lowers the compression ratio. It also results in lower horsepower required; less volume delivered; and uniform maximum design discharge pressures maintained. Thus, with two motors in operation, 83% of design volume can be pumped requiring 53% of maximum power capacity. At 90% capacity, the power requirements are 70% of the maximum horsepower.

When variations in gas demand occur, the starting or stopping of complete stations or units in a given station are ordered by a central dispatcher. The same flexibility of operation is obtained as would be possible with a pipe line equipped with centrifugal pumps handling liquids.

In the case of the "Big Inch" stations, all six of the motors carry approximately equal loads. Each centrifugal compressor exerts the same pressure differential. Three of the units in the 24-in. side are in series. These operate in parallel with the three series-connected units on the 20-in. side. The discharged gas passes into the manifolded 24-in. and 20-in. header and distributes itself in the two lines based on their relative capacities. The ratio of these capacities is about 1 to 0.6 respectively.

Economic Analysis

Conventionally, natural gas transmission uses gas engine driven reciprocating compressors, with station compression ratios averaging 1.8. These compressors need about 35 hp per million cubic feet of gas per day, and are spaced an average of 100 miles apart. This type station will cost approximately $200 per hp installed complete with auxiliaries such as cooling tower and cottages. If the stations were spaced about 50 miles apart and with initial pressures of 750 psig, the compression ratio be-



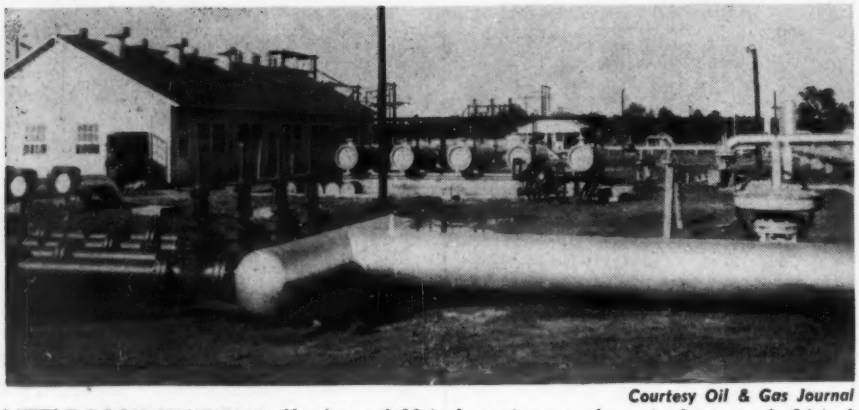
"Big Inch" Performance Before Conversion

CUMULATIVE deliveries of crude oil and oil products by the electrified "Big Inch" system during war years are shown by the chart. A total of 367,822,000 bbl were transported. Power utilities received $15,890,000 total revenue. Net profit to the government's Defense Plant Corporation during the war was $182 million, exclusive of depreciation. Capital investment was about $145 million. In January 1947 the whole system was sold for $143 million to natural gas interests.

The system, as discussed in detail in Electrical World, July 24, 1943, pg 44, consists of two lines: (1) The "Big Inch", a 1,254 mi long 24-in. pipe line originally for crude oil; and (2) "Little Big Inch", a 1,475 mi 20-in. pipe line originally for oil products. Interesting facts include:

	Big Inch	Little Big Inch
Pumping stations, no	26	29
Motors per station	Three 1,500-hp 1,785 rpm	Three 1,250-hp 3,560 rpm
Total installed, hp	117,000	108,750
Energy consumed for total operating period, Jan. 1943–Aug 1945, kwhr	1,511,088,393	759,422,569
	For year 1944; transporting 1,254 mi	For 3-1-44 to 9-1-45; transporting 1,475 mi
Total volume pumped, bbl	114,258,000	105,960,000
Average energy per bbl, kwhr	6.6	7.15
Average electric pumping cost per bbl, cents	4.55	5.2
Average sustained load factor, %	88.9	66.2
Capacity factor, %	94.7*	82.5**
Shut down due to any electrical failure in terms of elapsed operating time, %	0.19	0.12
Total cost per bbl including administration, operation, maintenance, and communication, but without depreciation, cents	6.8	11.1

Average daily delivery of: *312,000 bbl; **193,500 bbl



Courtesy Oil & Gas Journal

LITTLE ROCK STATIONS. Header and 20-inch station are shown in foreground; 24-inch station in background.

comes 1.3 and the horsepower required drops to 12 hp per million cubic feet per day. This totals 24 hp for 100 miles of line. Compared to 35 hp with compression ratios of 1.8, about 30% is saved in required power equipment.

An electric motor driven centrifugal gas compressor station can be installed for $70 per hp, provided the serving utility furnishes the power line and transformers. Expensive cooling towers are eliminated because of relative low temperatures (about 130 F in summer) of the discharged gas at the lower compression ratio.

In the case of the "Big Inch" pipe lines, it was estimated that the stations could be changed over for gas pumping for about $30 per hp, since the original motors and switch-gear could be used. If the conventional gas engine-driven reciprocating compressors were installed, an additional outlay of about $20 million more than the electric-centrifugal cost would be required.

This additional investment of $20 million was based on having to equip 12—7,500-hp stations from No. 5 at Little Rock, Ark. to No. 20 located south of Pittsburgh, Pa., and 4—3,750-hp stations at No. 2, No. 4, *F* and *G*, shown on the map. At this time, the principal deliveries of gas are to be made to Eastern Ohio and Southwest Pennsylvania, the location of Stations No. 19 and No. 20. Five stations on the system will use gas engine-driven reciprocating compressors since sufficient electric capacity is not readily obtainable.

Ordinarily, because of the nature of the load, a long gas pipe line with underground storage facilities to absorb the excess summer capacity will deliver about 90% of its design maximum capacity.

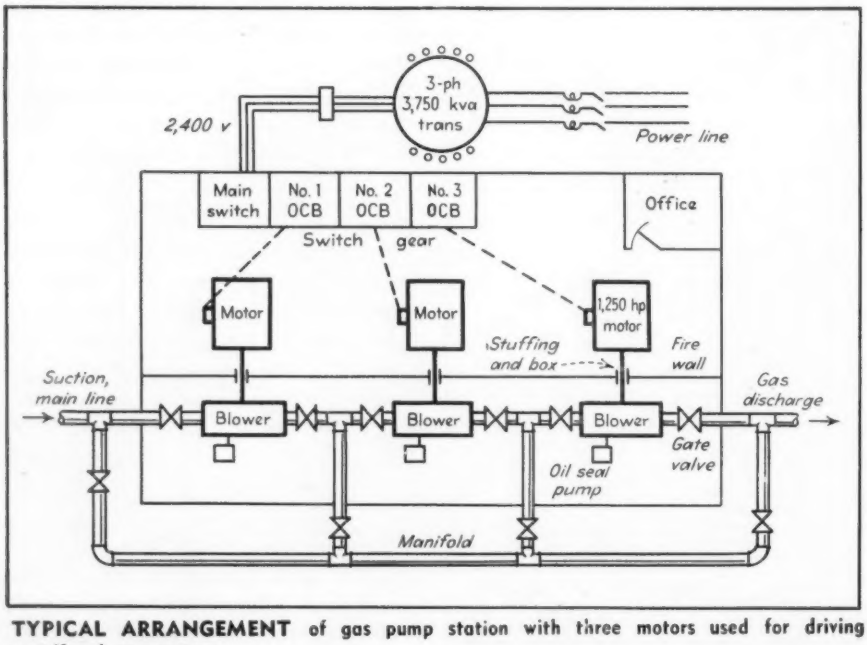
Gas pipe lines are permitted to earn from 6 to 6.5%, and depreciation rates allowed on pump stations are 3.5%. Taxes and insurance rates generally amount to 1%. Operating labor and maintenance total about $12 per year per hp for the gas engine station, as compared to $5 for an electric centrifugal station. Since gas is taken from the line to operate the gas engine, the proper charge as fuel for pumping would seem to justify costs of its value at destination. Each station consumes almost as much gas in a year as is the daily capacity of the line, when operating at 90% capacity factor. If pumping were done electrically, the gas used by the engines could be sold.

Based on increased coal values, today electric power costs approximate 0.8¢ per kwhr. This is perhaps 15% higher than those obtained by the "Big Inch" lines during the war.

Based on all factors of operating expense and applying these costs to the "Big Inch" system, it was found that the gas engine reciprocating compressor stations would operate about 15% cheaper than the electric centrifugal compressor stations would operate under given capacity conditions. That is, provided only the nominal field charge was made for gas fuel consumed by the engines. But if with electric centrifugal operation, the increased revenue from the additional gas is considered then the gas engine-driven stations cost 20% more than the electric-type station.

The use of electric centrifugal compressors for natural gas transmission opens up an entirely new field of power sales for the electric utility. Utilities serving the "Big Inch" stations with its present 105,000 hp connected, will probably receive annual revenues of approximately $5 million.

The engineering pioneering of "Big Inch" system will probably find increasing use. For example, electric centrifugal compressors of 6,000-hp capacity are being installed in Kentucky as an intermediate booster station between existing gas engine stations. This will increase the capacity of the line about 20% and save the cost of installing several million dollars' worth of parallel "loops".



TYPICAL ARRANGEMENT of gas pump station with three motors used for driving centrifugal compressors

Providing Fire Protection For Transformers

Emulsion-forming spray system installed to extinguish transformer oil fires . . . Electrical clearances maintained between energized electrical equipment, water projectors and associated piping

J. J. BURRI
Superintendent of Distribution
Staten Island Edison Corp
St. George, S. I., N. Y.

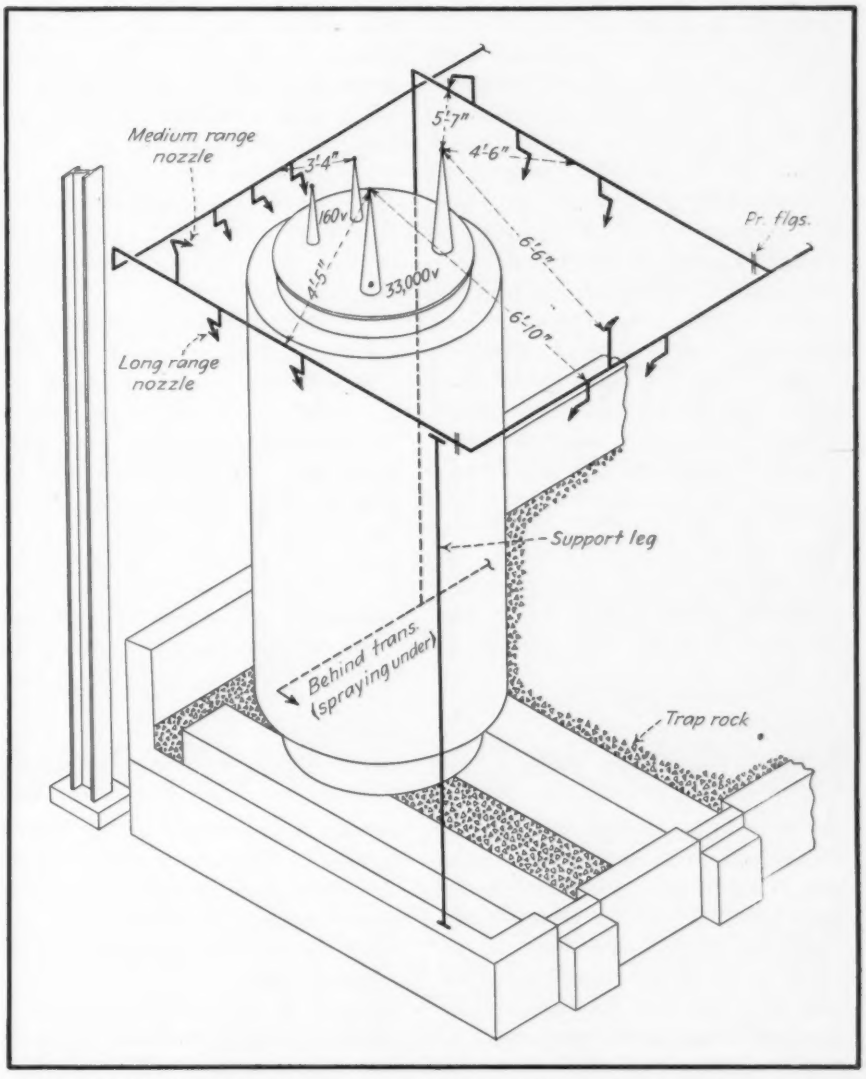
FIRE PROTECTION at the Livingston Substation of the Staten Island Edison Corp is hampered by the fact that a public street runs directly through the plant. Our generating station is on the north side and our office building, transformers, switchgear and garage are on the south side of the street. A severe transformer fire would not only be a hazard to nearby equipment but might endanger persons and vehicles using the thoroughfare.

Difficult Layout

The layout caused us considerable anxiety during the war years. One side of the transformer yard was protected only by a 7-ft fence running along the public sidewalk. As protection against hand-thrown missiles, we erected a 25-ft chicken-wire extension above the regular fence. This, together with the additional police patrols furnished during the emergency, eliminated troubles caused by our unusual exposure.

Protection of our transformer yard against fires originating within the transformers themselves had to wait until the war ended. Then we set about selecting protection that would meet the rather severe safety requirements necessitated by our situation. We needed quick and positive extinguishment to prevent the spread of any fire to adjoining transformers. The protection must not create additional hazards nor reduce clearances for electrical safety.

In selecting protection for our transformers we attempted to survey all of the methods recognized by insurance authorities and to check our impressions against the experience of others in the power field. For reasons of economy our choice was narrowed down to the methods using dispersed water as the extinguishing agent for fires in transformer oil. We considered (1) the "fog" method which depends upon cooling and smothering action by fine spray or fog, and (2) the "emulsion-forming" method which creates an unburnable emulsion at the surface of the oil by



ISOMETRIC VIEW of Mulsifyre system on 2500 kva, 33-kv, single-phase OISC transformer, showing clearances between energized parts and spray nozzles

subjecting it to high-velocity spray. Use of a form of protection whose effectiveness would not be lessened by occasional high wind velocities was important. We thus favored the larger droplets and better directional discharge obtainable with high-velocity sprays.

We examined Grinnell Mulsifyre installations and viewed motion pictures of transformer fire extinguishing tests which the Philadelphia Electric Co had conducted at their Plymouth Meeting Substation. For their tests they had used the tank of a 6,250-kva, 66/13.2-kv single-phase OISC transformer which had been damaged in a fire at one of their substations. All 25 radiators were left in place on the tank and the manhole in the top was left open. A dyke 16 ft in diameter was constructed around the transformer and filled to a depth of 12 in. with crushed stone over approximately half its area, the other half having a tamped clay surface to simulate concrete.

For the fires, of which color motion pictures were made, the tank and radiators contained 1,500 gal of used transil oil floated on 2,300 gal of water. A 2-in. water supply line containing a meter fed into the bottom of the tank to raise the level and spill oil out during the fires. Meter readings from this line and also from the "Mulsifyre" supply lines gave the quantities of oil spilled during the fires and the amount of water used to extinguish the resulting fires.

To ignite the fires, 50 to 75 gal of oil were spilled around the base and over the sides of the transformer. Then approximately 7 gal of gasoline were spread around the top of the tank, over the windward side and over the pool of oil at the base of the tank. The fires were started and permitted to burn until sufficiently severe to simulate the worst conditions before water was turned into the Mulsifyre system.

Four fires were lighted. The main body of three fires was extinguished within 15 sec. Due to a leaky radiator on one side of the tank a small fire persisted up to 48 sec near the base in a fourth fire. Water requirements were 400 gal for each of three of the fires and 540 gal for the fourth, using for these tests pressures at the nozzles between 55 and 65 psi.

Reports which we heard related to the successful operation of such systems in three specific fires—(1) at the Nebraska Power Co in Omaha (now Omaha Public Power District), (2) at the Millers Ford station of the Dayton Power and Light Co in Dayton, Ohio, and (3) at an unusual fire and explosion at the Queen Street Substation of the Quebec Power Co, starting in two circuit breakers. In the latter case, the explosion of oil spray and vapors from the circuit breaker tank blew out three outside walls and buckled the fourth wall, causing flying blocks of masonry to damage the outdoor bus structure. The water distribution system for the Mulsifyre installation was not, however, disabled and the fire was extinguished without outside assistance.

The nine transformers we have to protect include three 18,750-kva, Allis-Chalmers, 3-phase, oil-insulated, air-cooled transformers with windings for 33,000 v on the high-voltage side and two windings for 13,800 v and one winding for 6,900 v on the low-voltage side. There is also a bank of three 2,500-kva, General Electric, single-phase 3-winding transformers, delta-connected, with 33,000 v on the high-voltage side, and 2,500/4,330 v on the low-voltage side. Another bank consists of three 2,500-kva, Westinghouse, single-phase transformers delta-connected with 33,000 v on the high-voltage side and 2,400/4,160 v on the low-voltage side.

The broken spray discharged from the nozzles is non-conducting. The minimum distance employed by the manufacturer of the transformer for the separation between high-voltage leads can usually be adopted as a minimum distance for the separation of the nearest water-supply piping or nozzle from a live conductor. In most installations of emulsion-forming spray systems those safe clearances can be and generally are exceeded. The rather long-range effectiveness of those sprays does not require closeup application. Nozzle designs provide a variety of angles of discharge and configurations of the patterns of discharge.

It is important that the water supply pipes be permanently connected to the ground of the electrical system. Routine periodic tests of Mulsifyre systems at our own and other stations, without killing any of the buses, testify to the safety of these procedures. Electrical danger conditions within the protected area during operation of the sprays may be likened to the conditions produced by a heavy rain storm.

Control of the Mulsifyre systems at the Livingston Substation in case of fire is fully automatic. Each of the large transformers and each bank of smaller transformers is equipped with Multitrol detector heads. Those heads operate on the rate-of-rise principle to release Multitrol deluge valves that let water into the piping to the area that is affected.

Boring Machine And Clam Shell Sink Tower Footings

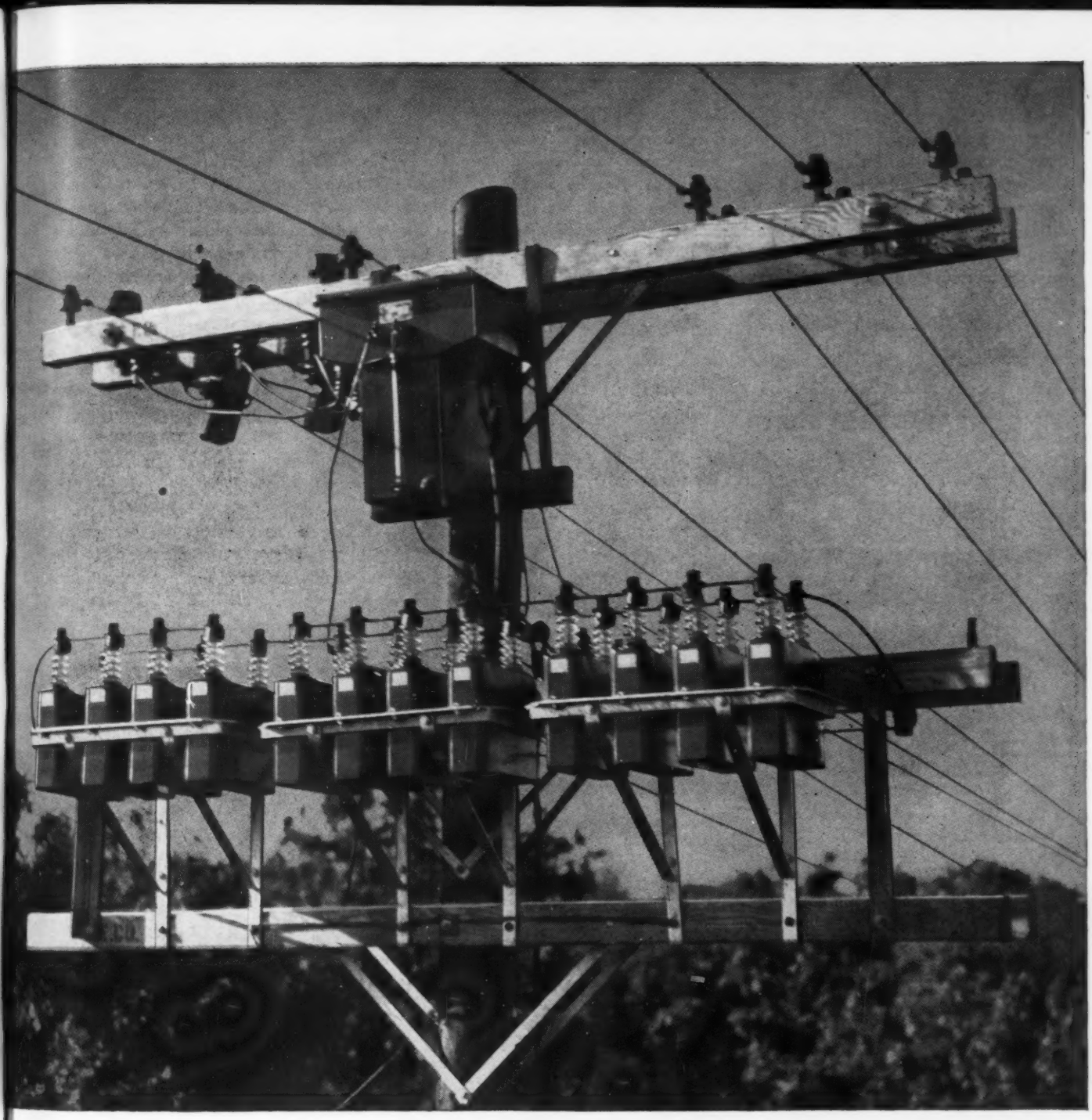
A POLE-HOLE DIGGER and a clam-shell shovel in combination to excavate transmission tower footings is being tried out on the Pennsylvania Power and Light Co. system.

Experience to date appears to confirm the hope that footings can be dug in this manner to more exact dimensions than with the clam-shell shovel alone. This reduces the amount of transit mix concrete used in the field. Often such concrete has to be hauled considerable distances to remote tower sites and is too expensive to "waste" in oversize footings.

Procedure used by PP&L in digging footings by this method is to drill 16-in. holes with the boring machine at appropriate spacings (10 to 14 in.) around the perimeter of the desired excavation and to the desired depth. The clam shell moves in after the boring machine, digging out the core of earth that was "outlined" by the boring machine.

Result of this procedure is an excavation with clean, straight, perpendicular sides from top to bottom. Since the side does not slope in, as was the case with other digging methods, the yardage of concrete required for each hole is kept to a minimum. Also there is no need to put men in the hole to "square it up" with hand shovels.

The time required to sink a footing is about the same time as formerly. The principal saving is in the amount of concrete required for the footings.



stallation, so that the system benefit from the locally supplied kilovars does not depend on temporary conditions on individual feeders.

"We now have more peak-load capacity, less voltage drop and lower distribution and transmission losses, than any of our other proposals could have provided. The total cost for these capacitors has been lower than the expenditure which otherwise would have been necessary."

The purpose of these advertisements is to encourage electrical utilities to exchange information on the use of power-factor-improvement capacitors. We believe that such an exchange will best bring out that capacitors can be used much more widely than at present—that they provide the fastest way of increasing peak-load capacity—that they can bring many utilities extraordinary returns by increasing capacity of existing distribution lines, transmission lines, transformers and circuit breakers—and that they offer one of the best possibilities of scaling down system costs per kilowatt. If your experience with capacitors would be of interest and value to other companies, we would like to hear from you. Contact your G-E Representative or write *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

GENERAL ELECTRIC

407-126

state for at least 10 years. Also a recent study of hardware life indicates that 10 years is the minimum service life for banding used. Assuming both these estimates to be correct, each additional year of pole life resulting from this top treatment costs 11 cents on the basis of $1.08 treatment cost per pole.

In addition to the reduction in annual operating cost resulting from the extended service life of poles with this type of treatment, a considerable saving is made in the company's pole timber requirements. The supply is limited and the task of meeting the demand of pole consumers with grades of timber required for certain uses is difficult.

Pole costs today are therefore higher than 20 years ago, partly because of increased labor and production costs and partly because of depletion. In the face of these facts and the present economic structure it is of paramount importance to reduce annual operating charges on pole plant in service. The company's present treatment program is designed to achieve this end.

Accurate Electrical Dynamometer

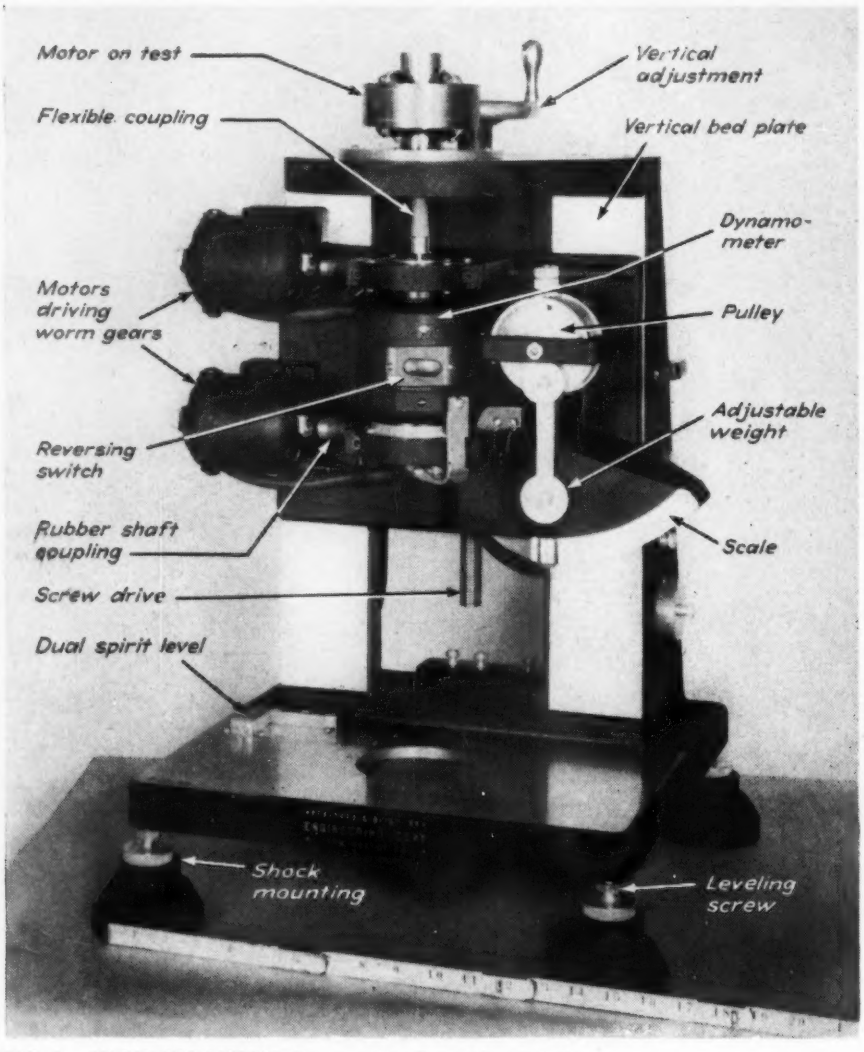


FIG 1—HIGH PRECISION dynamometer for testing motors

J. E. DUFF
Hoover Company
Canton, Ohio

A DYNAMOMETER that minimizes errors caused by mechanical weaknesses and is satisfactory for testing many small motors is shown in Fig 1. The following operating and constructional details of the dynamometer are based on an AIEE paper presented last year at the Middle Eastern District Meeting.

Loads up to nearly 40 w can be absorbed by the dynamometer operating either as a motor or a generator at 3,600 rpm. During some special test runs the performance was still satisfactory as an induction generator at 7,200 rpm at an output of 65 w. The principles apply for larger dynamometers but probably absolute error limits will be greater.

When used as a generator to absorb power, its sensitivity is well below the 1% of total torque. Usually the dynamometer is loaded as an induction generator. But for tests of starting torque, the fields are excited with d-c and it is used as an absorption dynamometer. For short runs heating is not excessive.

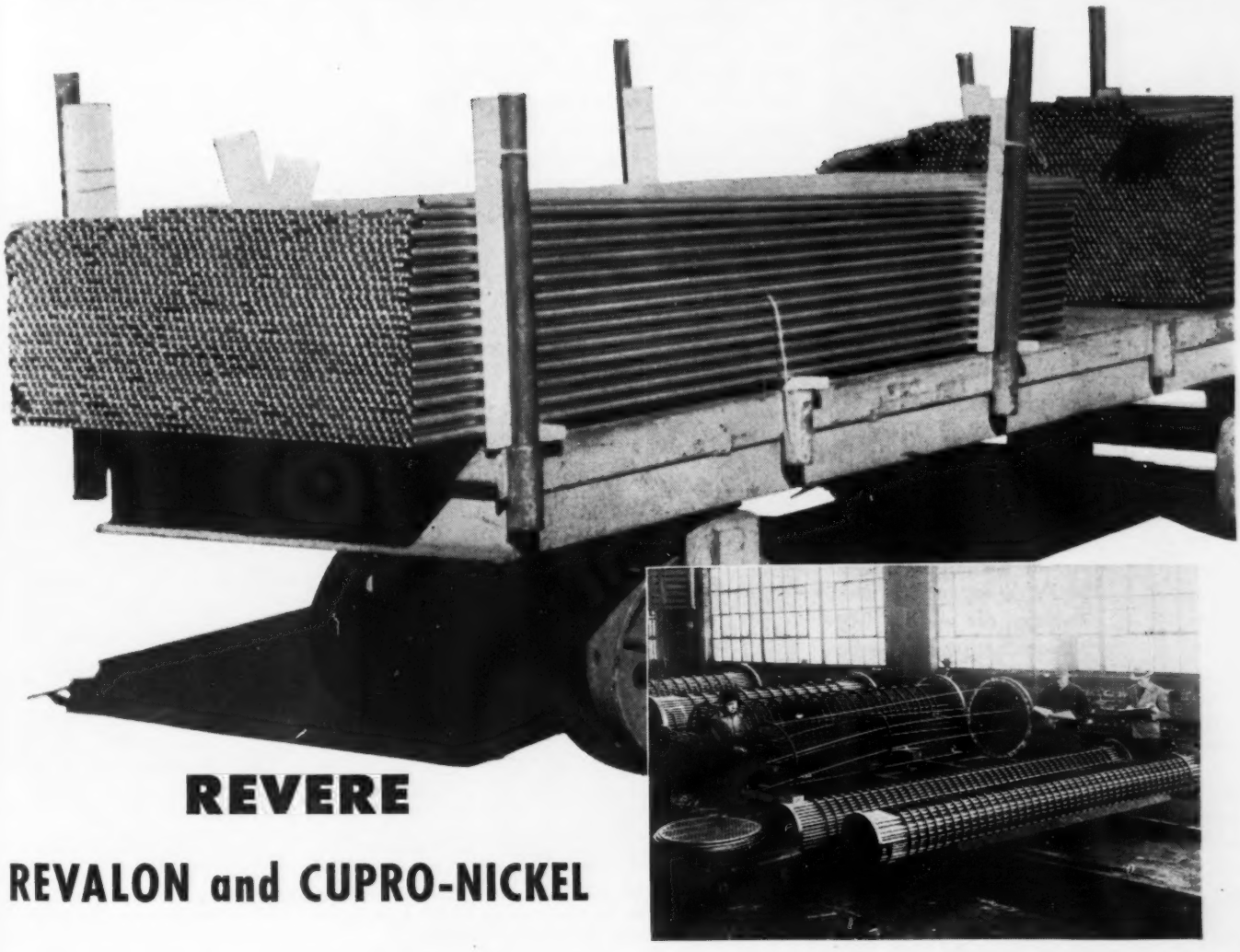
When used as a driving motor to measure bearings and windage losses the full advantages of the unusual dynamometer bearing arrangement appears. Even when using the lowest output scale, readings of torque can be repeated to within one scale division. At 3,600 rpm this represents only 0.03 w output.

Ingenious Mounting

The high degree of accuracy in torque measurements is due to the dynamometer trunnion bearing arrangement shown in Fig 2. Some large dynamometers use oscillation of the outer races of the trunnion bearing to reduce the static or low speed rotary motion friction of the dynamometer trunnion bearings. Friction is reduced by keeping the inner and outer races of the trunnion bearings moving at a relatively high velocity as compared with their normal motion in following dynamometer torque changes. The dynamometer in Fig 1 not only provides high relative motion of the trunnion-bearing races but is arranged so that the dynamic friction so introduced is in opposite directions for the upper and lower bearings.

In operation, both the upper and lower worm wheels are driven in opposite directions at about 50 rpm. This bearing rotation in opposite directions helps cancel static friction

MEETING SPECIAL CONDITIONS



REVERE

REVALON and CUPRO-NICKEL

Because each condenser and heat exchanger presents its own special combination of conditions, no blanket recommendations for condenser tube alloys are possible. However, this much can be stated authoritatively: there are three Revere Metals which deserve special consideration in cases of limited or unsatisfactory tube life. Here they are:

Cupro-Nickel, 30%. Withstands high operating temperatures. A tenacious surface film forms on this metal, which resists impingement attack and erosion, salt water, and waters containing organic material. Widely used in marine and seaboard installations, the tropics and subtropics.

Cupro-Nickel, 20%. Similar to Cupro-Nickel, 30%, but lower in price and somewhat less resistant to certain types of corrosion.

Revalon (Aluminum Brass). This Revere Metal contains a small proportion of aluminum, which gives it a long life in applications where water velocities are high or water is saline. The film formed on this tube is tenacious and self-healing, rendering it highly resistant to impingement attack.

Which of these types to select, or which of the five other types of Revere Condenser Tubes should be chosen, depends on individual conditions. The Revere Technical Advisory Service will gladly collaborate with you in arriving at a decision as to the most economical tubes for your plant.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N.Y.—Sales Offices in Principal Cities, Distributors Everywhere.

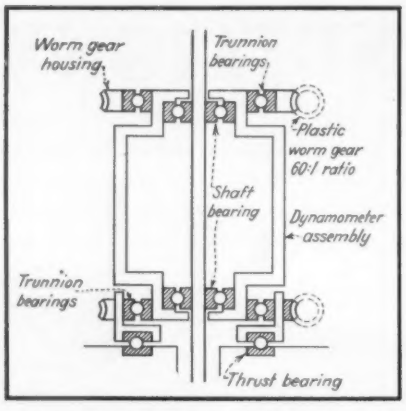


Fig 2—FIVE SETS of ball bearings help give the dynamometer exceptional accuracy

of the trunnion bearings thus resulting in more accurate reading of torque. These rotated trunnion bearings do not reduce any losses in the dynamometer bearings, but merely reduce the effect of static friction that causes the trunnion-bearing position normally to lag behind the true torque value.

To compensate for any artificial torque caused by differences in drag of the two bearings, the motors driving the two worm gears can be reversed and their speeds controlled if a sufficient change of reading should occur.

Electrical Design

The dynamometer unit is a modified 4-pole shaded-pole General Electric Co type KSP induction motor. Other than the bearing modifications, the only change was removal of the shading coils. The shading coils were replaced by a pair of wound coils (one pair on each pole face) of 10 turns of No. 22 HF magnet wire. The corresponding coils on the four poles are connected in series and the two circuits brought to a single-pole, double-throw switch. When used as a motor the switch shorts either one circuit of shading coils or the other circuit to obtain the rotation that is desired.

Main Polar Windings

The number of turns and wire size are not critical. The main polar windings were not changed. But they should be if, for example, the principal use of the dynamometer was for speeds of less than 1,000 rpm and requiring low applied frequency. This can be done by keeping the product of field turns and frequency constant and choosing a wire size that keeps the current density constant.

Power is supplied to the dynamometer by two fingers dipping into a curved double trough filled with mercury. The trough is mounted in the rear of the dynamometer unit. The trough is milled from phenolic insulating material. The two contacting fingers are of stainless steel to prevent attack from the mercury.

The two bearing drive motors are Bodine Electric Co type C-3, 1/30 sp, 225 v, 60 cycle 4,000 rpm units. To reduce the overall effect of vibration, smooth operation of the drive is quite essential.

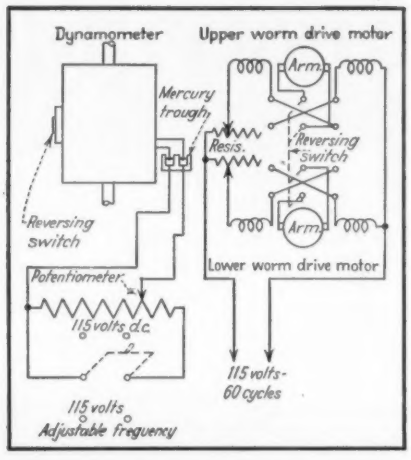
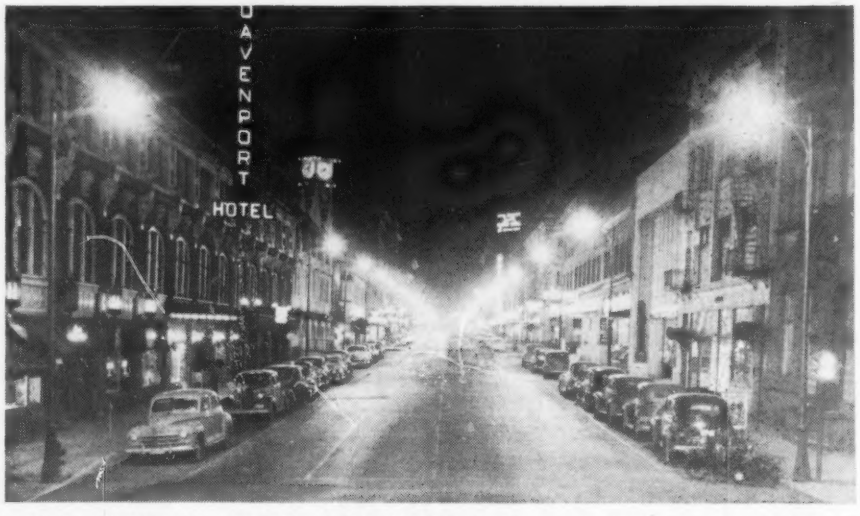


FIG 3—SCHEMATIC electrical circuit

Modernization Of One Street Lighting System



STREET LIGHTING SYSTEM MODERNIZED in downtown business area of Spokane, Wash. Pendent type luminaires have 16,000-lumen mercury-vapor lamps; mounting height 26 ft on new standards spaced 90 ft parallel

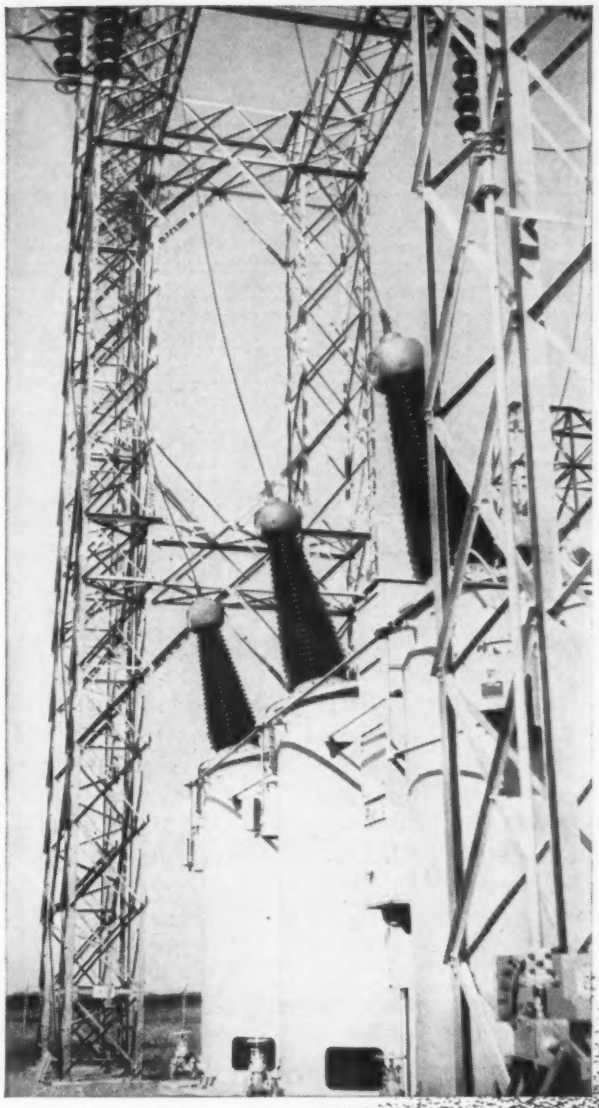
ANCHOR ROD HOLE is being reamed in old pole base to permit the use of larger diameter anchor rod. Portable air driven motor and ship reamer saved many man-hours

ALBERT GRUBER
General Industrial Engineer
The Washington Water Power Co
Spokane, Wash.

IN THE BUSINESS AREA of downtown Spokane, Wash. modernization of the ornamental street lighting system involved replacement of both standards and luminaires. A total of 230 lighting units have been changed on the bases which are retained on a spacing 90 ft parallel. Electrically the series street lighting system was changed from d-c to a-c operation.

Each of the installed ornamental steel pole extensions consists of a 22-ft "octoflute" extension shaft equipped with a 4-ft upsweep mast arm. The standards are mounted on existing ornamental bases.

The pendent type luminaires have

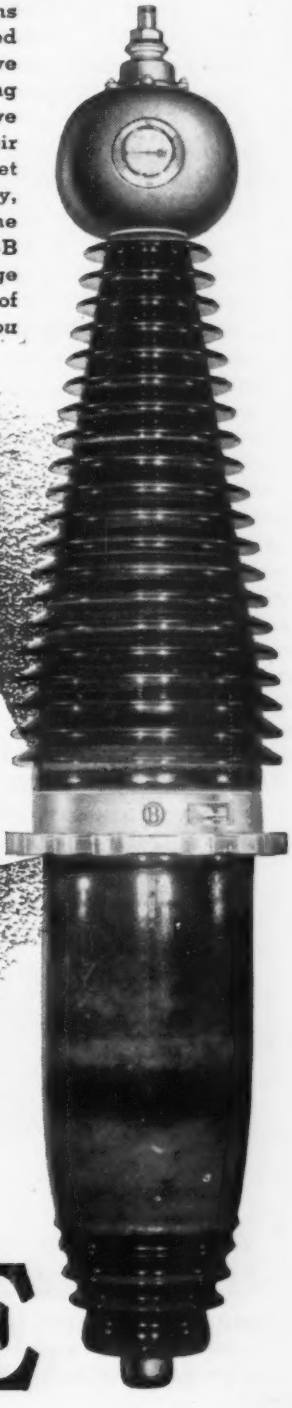


These two O-B bushing installations on the same power company are dated 20 years apart. Hundreds more have gone into service in the intervening years. Engineers on this system have measured O-B performance on their own terms; have attached their own set of values to O-B design and durability, and have voiced their opinion in the most tangible terms by specifying O-B bushings on their newest high-voltage apparatus. This is the final proof of satisfaction--the same satisfaction you can get by specifying O-B.

2871-H

Ohio Brass

MANSFIELD, OHIO



20 years' experience with O-B guides this

BUSHING PREFERENCE

asymmetrical light distribution and long alabaster globes. They are equipped with 16,000-lumen mercury-vapor lamps (FH-1) for operation on a-c circuits.

In the series circuit are connected IL transformers H-type, 6.6 amp series for the 400-w H-type lamps.

Mechanical steps required to modernize each standard include:

1—Completely dismantle old 13½-ft lighting standard and magnetite arc control mechanism.

2—Replace the existing ⅝-in. diam anchor rods with 1-in. diam rods.

3—Ream the anchor rod holes in the existing base from ¾-in. to 1⅛-in. diam.

4—Reset and level the ornamental base and install the IL transformers in a-c circuit.

5—Assemble the luminaire, secondary circuit, glassware, and mercury lamp on the 22-ft extension shaft.

6—Install the complete extension shaft assembly on the reset ornamental base.

7—Change circuit from d-c to a-c operation and connect secondary lamp circuit to control transformer secondary.

How the lighting system was put into a-c operation without service interruption will be presented in an ensuing issue.

BILL OF MATERIAL—Distribution

SHEET NO. 1 OF 3 SHEETS — MUNICIPAL LOCATION: CITY OF GARDEN CITY — WAREHOUSE FURNISHING MATERIAL: George Road — DATE ISSUED: 9-5-46 — WORK LOCATION NO. — BILL OF MATERIAL NO. 125849 PAGE 1

QUANTITY USED	QUANTITY ESTIMATED	STOCK NUMBER	POLE MATERIAL	QUANTITY USED	QUANTITY ESTIMATED	STOCK NUMBER	POLE MATERIAL CONT'D.	QUANTITY USED	QUANTITY ESTIMATED	STOCK NUMBER	POLE MATERIAL CONT'D.
Work Order 354A 3½											
Work Order 48B											
Work Order											
		100-0004	BG 2'-4" CR STONE			251-0303	1/2"x6" G M BOLT SH			142-0006	16" UG PIN
		992-0093	POLE CROSS	4	6	251-0337	5/8"x10" G M BOLT SH	•		240-0001	SCB ANC
•		141-0008	28" LT ARM			251-0339	5/8"x11" G M BOLT SH	•		240-0003	CONE ANC
•		141-0007	22" LT ARM	1		251-0341	5/8"x12" G M BOLT SH			100-0004	BG 2'-4" CR STONE
•		141-0011	82" MV ARM	1	2	251-0342	5/8"x13" G M BOLT SH	•		240-0002	EXP ANC
• 4	4	141-0002	60" LT ARM			251-0343	5/8"x14" G M BOLT SH			240-0004	ANC PLATE
•		141-0003	60" MV ARM	1		251-0344	5/8"x15" G M BOLT SH	•		240-0005	9" ANC ROD
•		141-0004	120" ARM	3	5	251-0345	5/8"x16" G M BOLT SH	•		240-0006	9" ANC ROD
•		761-0138	8" 3-BNS SEC BR	2		251-0347	5/8"x18" G M BOLT SH	•		361-0009	LB 1/4" STRAND
• 4	4	761-0172	4" 3-BNS SEC BR			251-0348	5/8"x19" G M BOLT SH	•		361-0010	LB 5/16" STRAND
•		761-0173	4" 4-BNS SEC BR			251-0349	5/8"x20" G M BOLT SH	•		361-0011	LB 3/8" STRAND
		251-0314	SEC BR D BOLT			251-0350	5/8"x24" G M BOLT SH	•		361-0012	LB 1/2" STRAND
• 1	8	240-0024	FL EARTH BR			251-0351	5/8"x28" G M BOLT SH	• 17	17	361-0046	LB 300 STRAND
•		240-0022	V ED ARM BR			251-0352	5/8"x30" G M BOLT SH	•		361-0008	LB 500 STRAND

BILL OF MATERIAL issued to the line foreman is corrected where necessary to show actual quantities used

O. H. Line Estimating—III: Construction Materials

THEODORE H. GUCK
Overhead Lines Dept
The Detroit Edison Co
Detroit, Mich.

LINE CREW foremen are furnished a complete bill of material for each job order, with quantities of each stock item required and space for his entry of the actual quantity used, in the estimating and layout method of The Detroit Edison Co. Record keeping of the foreman is reduced to a minimum with this system.

Two copies of the bill of material are turned in to the storekeeper who loads the truck and enters the quantities passed out. The storekeeper retains one copy of the bill of material and forwards one copy to the accounting department.

No other material forms are required. The foreman enters on his copy of the B/M the quantity used, and returns it to the office clerk when the job is completed.

* This series began in EW, May 22, 1947, p 146

Right-of-Way Treated To Improve Soil

EXPERIMENTS in soil improvement through the application of lime and fertilizer to transmission rights-of-way in central and northern West Virginia are recent developments in efforts of electric utilities to improve the appearance and condition of their rights-of-way.

SOIL IMPROVEMENT through the application of lime or fertilizer to right-of-way is being tried by Monongahela Power

The work is being done on the system of the Monongahela Power Co, Fairmont, as the result of conferences between the company's agricultural experts and Russell H. Gist, state agent for the Federal-State Agricultural Extension Service at West Virginia University in Morgantown.

Objective of the soil improvement program is the reclamation of lands along rights-of-way so that farmers may pasture cattle on good grass and legumes which will, it is believed, crowd out obnoxious growth when the soil has been brought into good condition. This should also lessen maintenance costs.

Chemical soil analyses are made by the University soil laboratory. Fertilizer and lime are applied to the soil where tests show that they are needed. The amounts applied vary with the chemistry of the soil. Work of spreading the lime or fertilizer is done entirely by Monongahela Power Co employees. The company has set aside $35 an acre to cover the cost of treatment.

The accompanying picture shows a typical right-of-way that has been treated with lime. The location is near Clarksburg, West Virginia. This strip, incidentally, was one of the best on the company property showing very little growth of undesirable grasses, shrubs and trees.

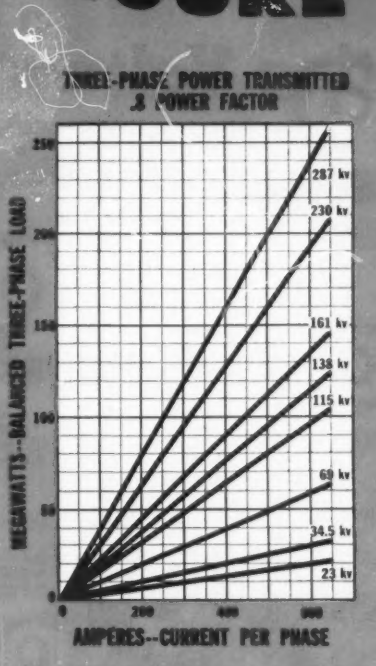
Other rights-of-way in Monongahela territory are to be given various kinds of soil treatment this year according to their needs. The company anticipates that the work will not only prove valuable as demonstrations of what can be done but may set a pattern for more far-reaching soil improvement practices.

Monongahela also sprays some of its rights-of-way with weed killing chemical solutions, particularly to eliminate various types of unwanted deciduous growth.

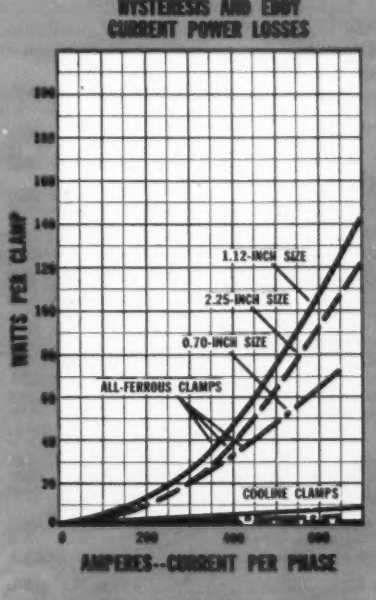
FIGURE IT YOUR OWN WAY

...Here's a Quick Route to a Simple Answer on O-B COOLINE Clamps

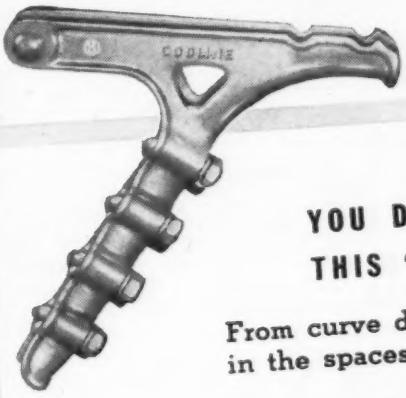
Take one of your typical lines now in operation, and put down its data on this "form". See for yourself what O-B's new Cooline hardware has to offer. You can prove by a process of simple arithmetic that this hardware brings an attractive savings to the operation of the average line above 69 kv.... Equally desirable, today, is the fact that O-B Cooline hardware is in good supply.... We will gladly provide more detail if your figures reveal the need for further investigation. Otherwise, place your order now for O-B Cooline hardware.



These facts must be worked in terms of current per phase. Find your transmission voltage at right and follow line down to where it intersects the horizontal ordinate corresponding to your balanced three-phase load in megawatts (1000 kw). From this point drop to bottom to find amperes per phase.



Select your amperes per phase along bottom line and read up to the curve for all-ferrous clamps corresponding closest to your own clamp size. Follow this point to the left margin where watts-loss per clamp is indicated. This figure is the basis for cost calculations and appears under (1) in the questions.



YOU DON'T HAVE TO SEND THIS "FORM" TO ANYBODY

From curve data, you can insert values in the spaces provided.

(1) Watt loss *each* of present clamps - - - - - - _____

(2) Multiply (1) by number of clamps on line - - _____

(3) Divide (2) by 1000 for total loss in kw. - - _____

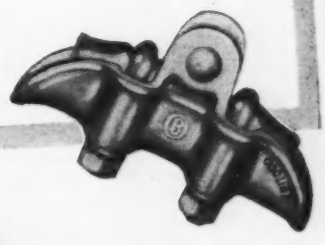
(4) Convert (3) to kwhr based on your load factor - _____

(5) Multiply (4) by your generating cost per 1 kwhr _____
The last figure is a *repetitive yearly saving.*

(6) Multiply (3) by your installed cost of 1 kw generating capacity at the station - - - _____

This figure represents the capital investment expended to keep your present clamps hot. Cooline hardware will put this capital to work earning a normal profit.

NOTE: For a rough estimate, the added cost of Cooline hardware over ferrous equivalents runs from par to not over $1.30 per clamp. The average is about one dollar. You pay this *only once,* while the above figures compound themselves over the life of the line



Ohio Brass

MANSFIELD OHIO, U. S. A.

CANADIAN OHIO BRASS CO., LTD. NIAGARA FALLS, ONTARIO

Short Method For Calculating Voltage

R. N. EARLY
Engineering Dept.
Electric Machinery Mfg Co
Minneapolis, Minn.

VARIATION OF VOLTAGE with load at the receiving end of a 60-cycle, 3-phase transmission system can be found by this method in a very short time with a slide rule. Specialized knowledge of transmission line characteristics is not necessary. All required data for solving simple voltage regulation problems is given in the accompanying tables and curves. The sequence of calculation is easy to follow and all steps are indicated in Table 1 together with three examples completely worked out.

Results obtained by this method are correct for short lines. The error increases with length of line to about 2% of the line regulation, or about 0.5% of the line voltage, for a line 50 miles long. By the introduction of a correction factor, Fig 4, for line charging current, approximately correct results can be obtained for lines up to 300 miles long. Item 16 of Table 1 gives the voltage regulation by short-line methods. Item 18 gives the regulation after correcting for the effect of charging current for long lines. It is not expected that this method will be used very often for high voltage, or long-line problems, but may be useful for quick determination of the approximate effect of contemplated load changes.

Regulation calculations are generally made for drop or rise in voltage at the receiving end of the line, due to adding or removing the total load. Often, however, it is necessary to find the effect on voltage regulation and power factor of a load added to an existing load; for instance, a motor starting or a unity or leading power-factor synchronous motor load added to an existing lagging power factor load. The procedure then is to first calculate the voltage regulation for the initial load; add the new load vectorially, and repeat voltage regulation calculations for the total load after the new load is added. The difference, of course, is the effect the new load has on line voltage regulations. A simple mathematical method of combining loads at different power-factors is given in Table 3.

TABLE I—Sequence of Calculations

Example	I	II	III
Item			
(1) Distance in miles, sending to receiving end	1	20	200
(2) Conductor size, equivalent copper	210	4/0	300,000
(3) Equivalent delta spacing in feet, see Fig. 1	2.5	3	17
(4) Line voltage at receiving end	2200	10,000	140,000
(5) KVA load at receiving end	662.5	1300	40,000
(6) Load amperes = 1000 − KVA ÷ $\sqrt{3}$ × E	173.5	75.2	165
(7) Cos θ or power-factor	0.80	0.80	0.80
(8) Sin θ of power-factor angle, from Fig. 2	0.60	0.60	0.60
(9) Resistance per mile for conductor size, from Table 2[a]	0.4403	0.2776	0.1966
(10) Ratio of reactance to resistance, from Fig. 3	1.46	2.29	4.15
(11) Per unit resistance = $\frac{\sqrt{3} \times \text{Item (1)} \times \text{Item (6)} \times \text{Item (9)}}{\text{Item (4)}}$	0.0603	0.0722	0.0803
(12) Per unit reactance = Item (10) × Item (11)	0.0883	0.165	0.333
(13) Power component = Item (7) + Item (11)	0.8603	0.8722	0.8803
(14) Reactive component = Item (8) + Item (12)	0.6883	0.765	0.933
(15) Impedance = $\sqrt{[\text{Item (13)}]^2 + [\text{Item (14)}]^2}$	1.102	1.160	1.288
(16) Voltage regulation neglecting charging current = [Item (15) − 1.00] × 100	10.2%	16.0%	28.8%
(17) Correction for charging KVA, from Fig 4[b]	0.00	0.00	8.82
(18) Corrected voltage regulation = Item (16) − Item (17)	10.2%	16.0%	19.98%
Voltage regulation by rigorous mathematical method	10.1%	16.97%	19.67%

[a] If the conductor is aluminum, use equivalent copper section from Table 2.
[b] From Kuhlman Kurrents (date unknown).

TABLE II—Cable Data

Cable Size: Copper H. D. Stranded, 97.3% Conductivity — No.	Cable Size: Copper H. D. Stranded, 97.3% Conductivity — Cir. Mils	Cable Size: Equivalent Aluminum, steel reinforced	Resistance per Mile at 25 C (77 F): D-C	Resistance per Mile at 25 C (77 F): 60 Cy.
6	26,251	4	2.229	2.229
5	33,102	3	1.768	1.768
4	41,741	2	1.402	1.402
3	52,635	1	1.112	1.112
2	66,371	1/0	0.8815	0.8819
1	83,693	2/0	0.6991	0.6995
1/0	105,535	3/0	0.5544	0.5549
2/0	133,077	4/0	0.4396	0.4403
3/0	167,806	266,800	0.3486	0.3495
4/0	211,600	336,400	0.2765	0.2776
	250,000	397,500	0.2340	0.2354
	300,000	477,000	0.1950	0.1966
	350,000	556,500	0.1671	0.1690
	400,000	636,000	0.1462	0.1484
	450,000	715,500	0.1300	0.1324
	500,000	795,000	0.1170	0.1197
	600,000	954,000	0.09749	0.1007
	700,000	1,113,000	0.08357	0.08725
	800,000	1,272,000	0.07312	0.07729
	900,000	1,431,000	0.06500	0.06963
	1,000,000	1,590,000	0.05850	0.06358

TABLE III—Sequence of Calculations for Kilovars and Power Factor

Assume: A line is carrying 500 kva at 0.90 lagging power factor and a 150 hp, 148 kva, 0.80 leading power factor motor is started that draws 250 percent lagging kva from the line.
Problem: (a) What will the kva, kw and pf be at instant of starting? (b) What will the kva, kw and pf be when motor is running normally and carrying full load?

Calculation Procedure

Step	Ref.	Operation	Problems (a)	Problems (b)
(1)	.....	Initial line kva	500	500
(2)	.....	Power factor, or cos θ	0.90	0.90
(3)	Fig 2	kvar factor, or sin θ	0.435	0.435
(4)	.....	Added kva	370	148
(5)	.....	Power factor, or cos θ	0.30	0.80
(6)	Fig 2	kvar factor, or sin θ	0.954	0.60
(7)	(1) × (2)	$kw_1 = kva_1 \cos \theta_1$	450	450
(8)	(4) × (5)	$kw_2 = kva_2 \cos \theta_2$	111	118.4
(9)	(7) + (8)	$kw_{12} = kw_1 + kw_2$	561	568.4
(10)	(1) × (3)	$kvar_1 + kva_1 \cos \theta_1$	217.5	217.5
(11)	(4) × (6)	$kvar_2 = kva_2 \cos \theta_2$	353.0	88.8
(12)	(10) + (11)*	$kvar_{12} + kva_{12} \cos \theta_{12}$	570.5	128.7*
(13)	(9)²	$(kw_{12})^2$	325,000	325,000
(14)	(12)²	$(kvar_{12})^2$	327,000	16,600
(15)	(13) + (14)	$(kva_{12})^2$	652,000	341,600
(16)	√(15)	kva_{12}	806	582
(17)	(9) ÷ (16)	p. f.$_{12}$	0.695†	0.976†

* Add if power-factor is lagging, subtract if leading.
† Lag.

Regulation On Transmission Line

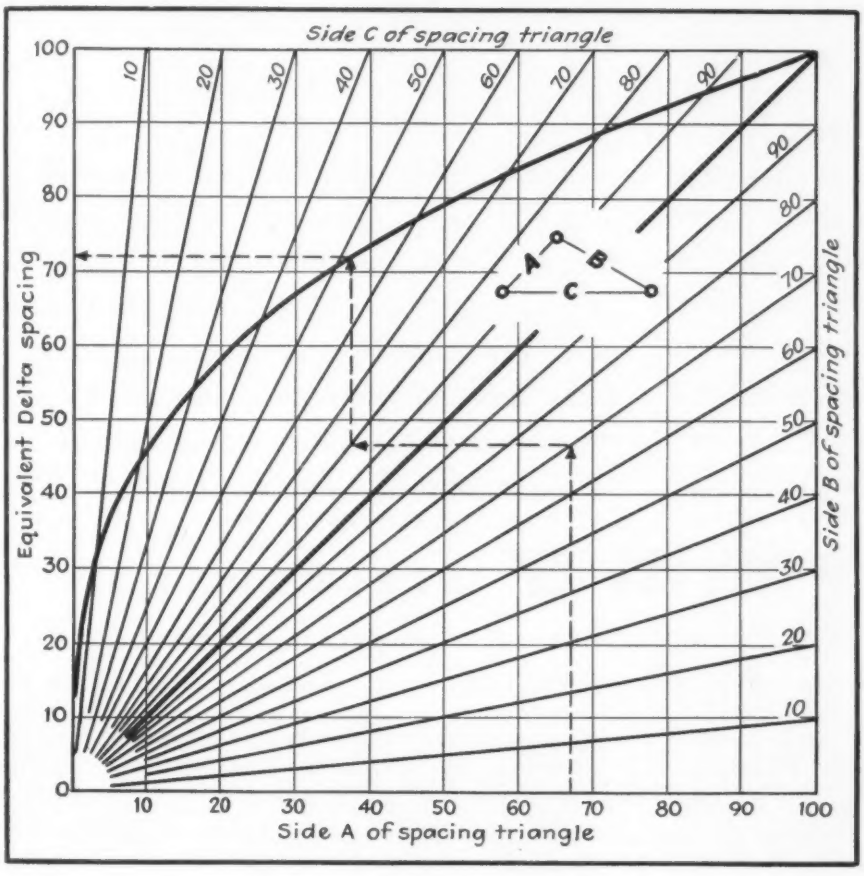


FIG 1—**GRAPHICAL** solution (left) of formula $3\sqrt{A \times B \times C}$ for equivalent delta spacing where A, B and C are distances between conductors shown by triangle.

Example: A = 67 in., B = 70 in., C = 80 in. Enter chart at bottom at 67 in. for side A and proceed upward as shown by broken line to 70 in. line for side B; then follow left to 80 in. line for side C. Projecting upward to curve and to scale at left shows 72 in. equivalent delta spacing

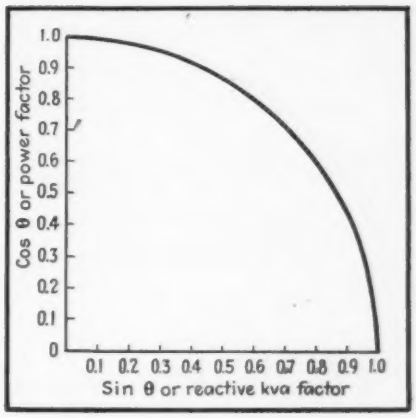


FIG 2—**KVAR FACTOR** for power factor

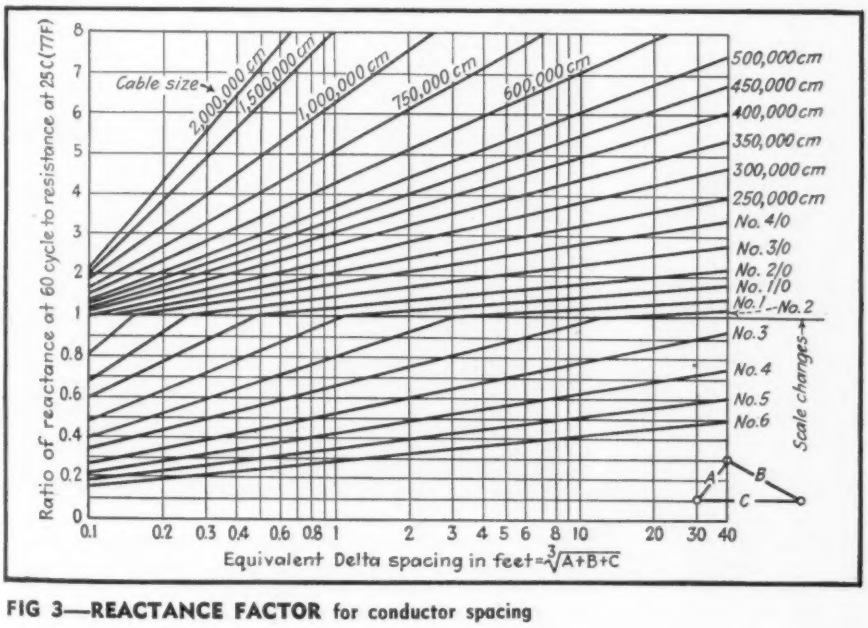


FIG 3—**REACTANCE FACTOR** for conductor spacing

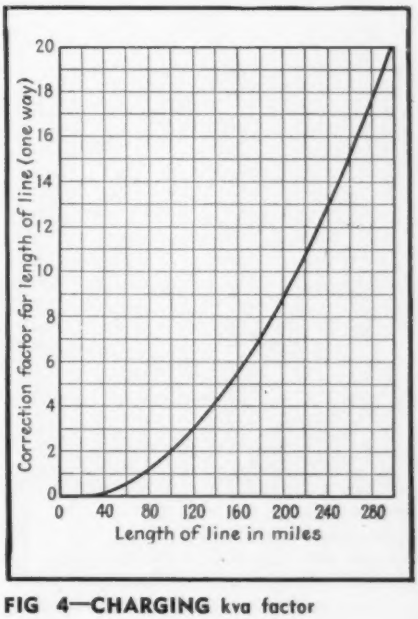


FIG 4—**CHARGING** kva factor

FINAL ASSEMBLY AND TESTING

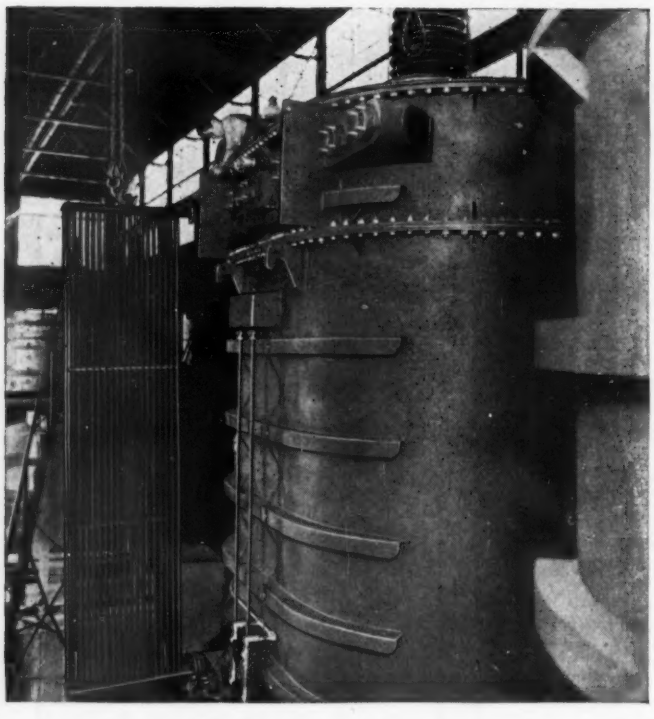
ANOTHER IMPORTANT PHASE IN THE MANUFACTURE OF

Power transformers represent a sizable investment for the purchaser, and he rightly expects them to provide many years of trouble-free service under average operating conditions. Of equal importance to him is the requirement of service continuity from a customer relationship standpoint. With these points in mind, the meticulous care that is exercised all through the earlier stages of production is not relaxed a bit during the final assembling and testing of Moloney Power Transformers. Close supervision and rigid inspection provide added assurance that the performance of the transformer in the field will measure up to the usual high Moloney standard.

MOLONEY ELECTRIC CO.

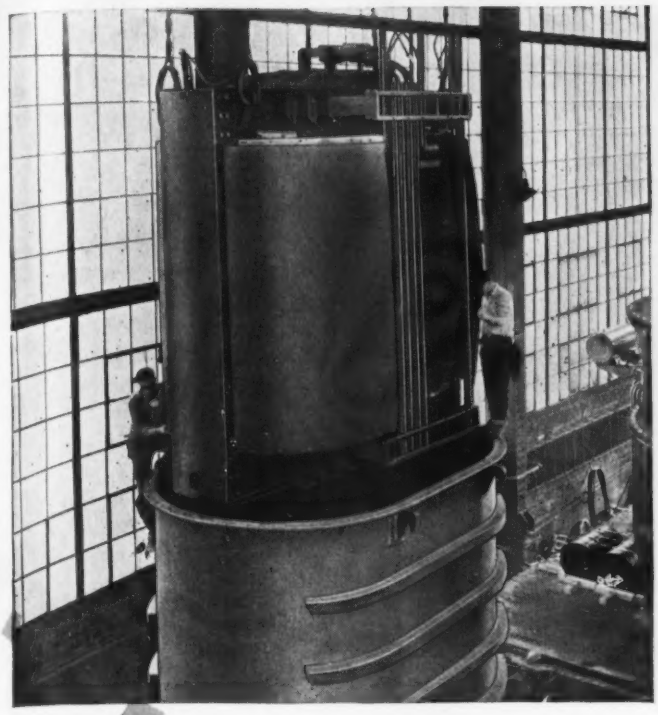
Power and Distribution Transformers Exclusively Since 1896

FACTORIES AT ST. LOUIS 20, MISSOURI AND TORONTO, ONTARIO, CANADA



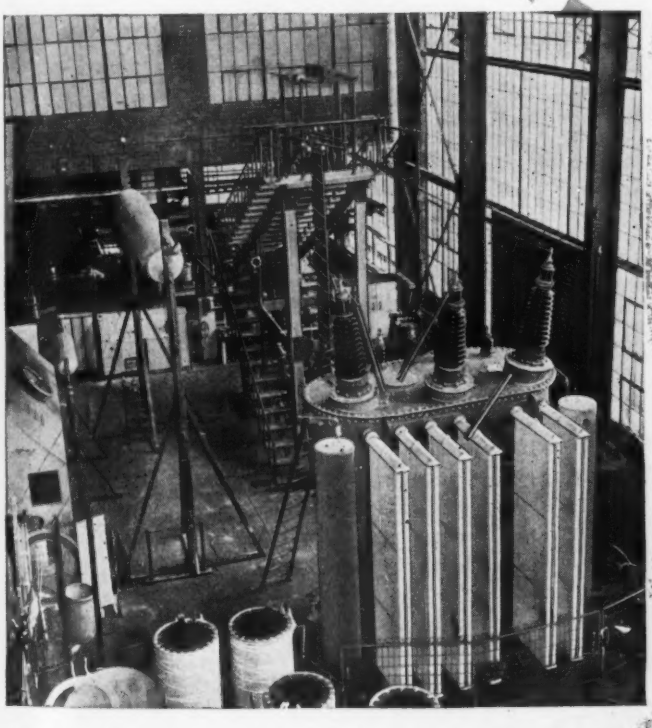
On small power transformers, the extra radiating surface necessary for dissipating the heat generated by the core and copper loss, is obtained by means of tubes or radiators welded directly to the tank wall. On larger power transformers extra radiation is provided by means of detachable radiators. Photo shows detachable type radiator being installed.

After the transformer has been completely assembled, it is thoroughly tested for possible leaks. In addition, the larger, high voltage transformer tanks are tested for ability to withstand *full* vacuum such as might be encountered in vacuum drying a transformer in its own tank in the field. Following this, standard electrical tests are made to assure performance in accordance with the guarantees.

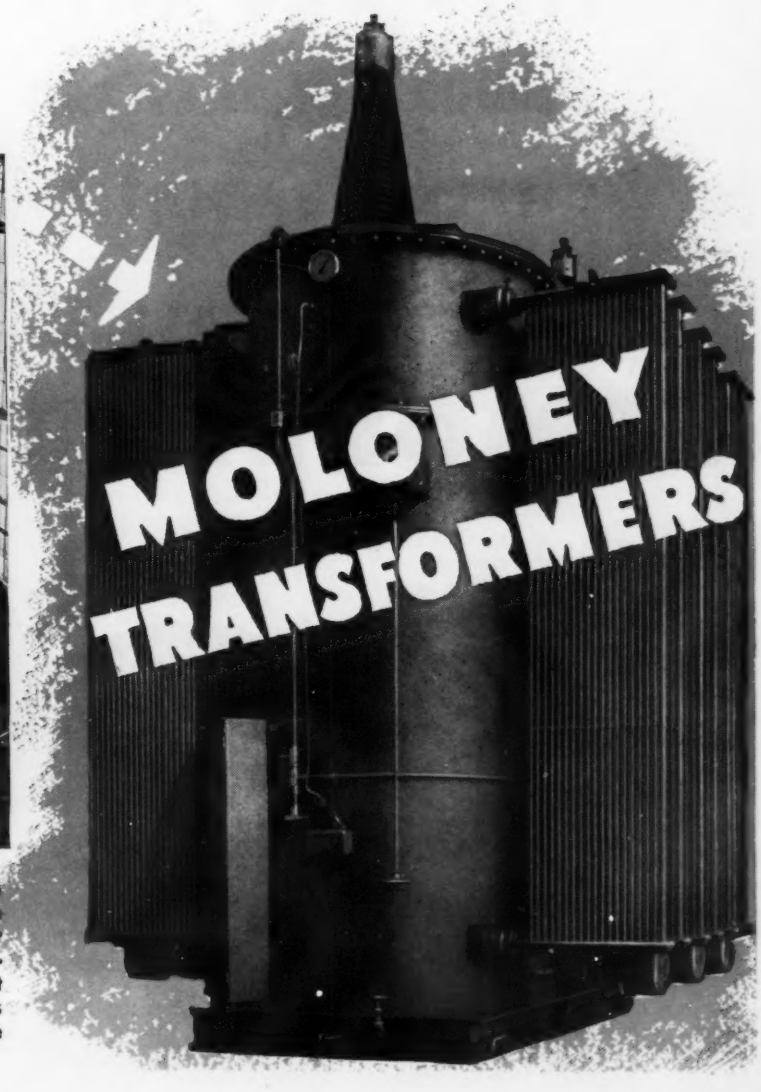


Following drying in a vacuum tank, the core-and-coil assembly is placed in its own tank, under oil. Channel guides provided on the inside of the tank to facilitate this operation, make it simple for the purchaser to remove the core-and-coil assembly for inspection, if desired.

After the core-and-coil assembly has been tanked and anchored securely in place, the tank cover is bolted or welded into position. The bushings are then installed. Photo shows a 115 Kv oil-filled bushing being lowered into position.



Frequently, purchasers specify that their transformers be impulse tested. This test is performed in the Moloney Surge Laboratory located at one end of the Power Transformer Assembly Department. Impulse tests, especially steep front-of-wave tests, simulate lightning conditions and are the most severe that can be imposed upon a transformer. The results of these tests are recorded on film by means of a cathode ray oscillograph.



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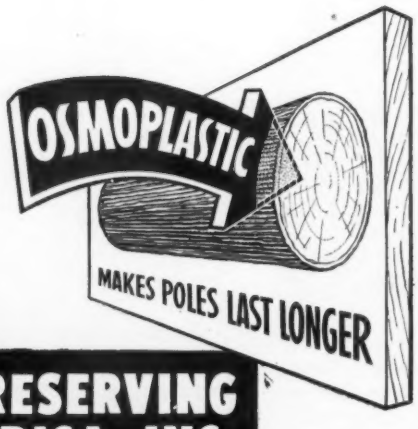


OSMOSE WOOD PRESERVING COMPANY OF AMERICA, INC.
GENERAL OFFICE AND PLANT: BUFFALO 12, N. Y.

Life Of Windings On Rotating Machines—III

A. F. AYRES*,
Riverside, Calif.

THE FOLLOWING operating experience deals with windings on hydro and steam generators and synchronous condensers in use on the system of the California Electric Power Co. All machines included are in either the 2.3 or 6.9-kv classification.

It would be impossible to consider all details of loading and ambient temperatures for these rotating machines, so they have been grouped according to insulation classification only. It is a known fact that some of the oldest machines or windings have been subjected to more favorable treatment in this respect than have some reported in the following failures.

41-Year Service

The two oldest generators on the system have each been in use 41 yr, and each is using its second Class A winding. The oldest machines still making use of their original Class A windings are two 39-yr veterans. Since the time of the first generator installation 41 yr ago, there have been 27 complete winding replacements. A few additional scattered coil changes have also been made. Of these 27 replacements, 25 were Class A insulation which resulted in an average life of 13.7 yr. The remaining two windings were of the combination A-B classification. These two averaged 17.5 yr life. Coils having Class A insulation between turns and Class B around the slot portion have failed as readily as a full Class A coil. The between-turn insulation becomes brittle, or charred, and internal coil failures result even though the insulation between coil and slot remains adequate. It is of great interest to note that this utility has never replaced a Class B winding.

One rather interesting example of this superiority of the Class B insulation concerns a small 2.3-kv synchronous condenser originally purchased and installed in El Centro, Calif. in 1914. Twelve years later, this machine was moved into a larger operating building. After giving eleven more years of satisfactory serv-

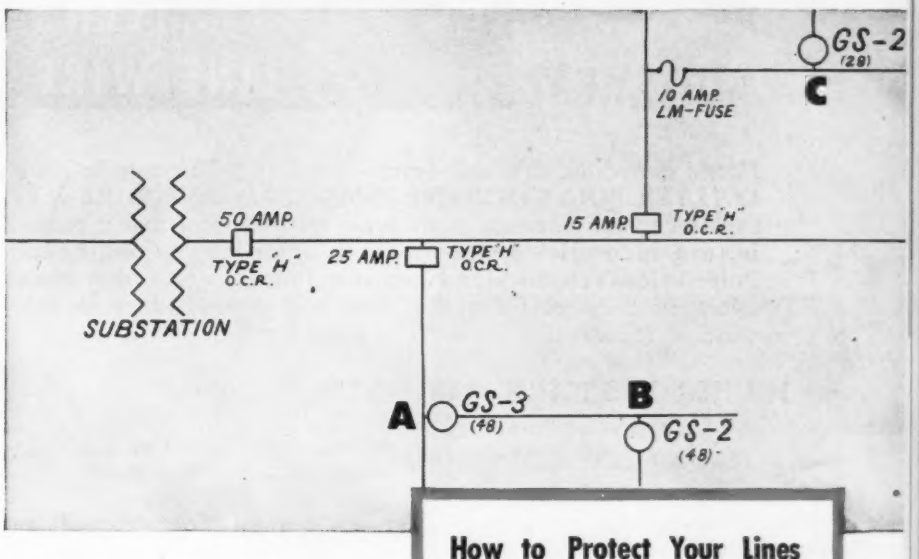
* Third in a series of four on life of windings which began in EW, May 22, 1948, p 152. Author is ass't electrical engineer, California Electric Power Co.

NEW...

KYLE TYPE "GS" SECTIONALIZERS

Provide Practical Method for Isolation of Permanent Faults to Branch Lines

This Kyle Type "GS" Automatic Oil Sectionalizer is a dependable automatic device for sectionalizing branch lines on distribution systems using oil circuit reclosers of ANY TYPE OR MAKE.



Does Not Open on Temporary Line Faults

Each short circuit on a branch line protected by a Kyle Type "GS" Sectionalizer partially prepares the sectionalizer for the opening operation. The actual clearing of line faults and interruption of short circuit current is performed by the back-up recloser.

Disconnects Only on Permanent Line Faults

The Sectionalizer operates to disconnect the branch line ONLY after one, two, or three operations of the back-up recloser have failed to clear the line fault. After the third recloser operation, the contacts of the Sectionalizer are opened during the time the recloser is open. In this way, the faulted line is disconnected. When the recloser energizes the system after the third operation, the fault has been removed and service is maintained on balance of system.

Automatically Reset After Temporary Faults

If the line fault is of a temporary nature, it will be cleared by the first or second operation of the recloser, and service to the entire system will be restored. Following this, the recloser and the Sectionalizer will automatically reset themselves for another complete cycle of operations.

Contacts Open Only During No Voltage Period

The Sectionalizer contacts are opened only during the no voltage period, during the time that the recloser is open. The Sectionalizer does not interrupt short circuit current. The result is no appreciable wear of Sectionalizer contacts or contamination of insulating oil. Sectionalizers may be set to open on a permanent line fault after one, two, or three operations of the back-up recloser, allowing coordination with each other.

How to Protect Your Lines With Type "GS" Sectionalizers

Point A Sectionalizer set for opening on third recloser operation, indicated by "GS-3".

Point B Further sectionalizing provided by placing Sectionalizer set for operation after second recloser operation, indicated by "GS-2".

Result: Fault beyond Point B will cause Sectionalizer "GS-2" to lock out after second recloser operation, maintain service on the branch line protected by Sectionalizer "GS-3" at Point A.

Point C Sectionalizer set for opening after two recloser operations, indicated by "GS-2", will isolate a permanent fault after second recloser operation before the back-up fuse is damaged or blown by the third operation of the recloser.

Ask your Line Material Representative to show you how these new Kyle Type "GS" Sectionalizers will improve the automatic operation of your distribution lines.

KYLE COMPANY SOUTH MILWAUKEE WISCONSIN

A DIVISION OF LINE MATERIAL COMPANY MILWAUKEE WISCONSIN

Here's something new and better — and at no increase in cost! COLLYER POLYETHYLENE INSULATED LINE WIRE is so superior to conventional triple braid weatherproof that it promises to gain complete acceptance for all future installations. Check Polyethylene's electrical and mechanical advantages . . . they mean extraordinary performance, life, and dependability in any weather, for any line service . . . always!

★ **HIGHER DIELECTRIC STRENGTH**

Comparative tests of #6 solid line wire:

	NEW MATERIAL	AFTER 28 MONTHS' WEATHERING
Triple Braid Weatherproof	2,800 volts	800 volts
2/64" Collyer Polyethylene	**29,000 volts**	**No Change**

★ **GREATER RESISTANCE TO ABRASION**

Comparative tests on duPont Abrader show Collyer Polyethylene has greater abrasion resistance than Triple Braid Weather-proof or even Neoprene or Rubber Jackets.

★ **LIGHTER WEIGHT (for longer spans and minimum sag)**

Comparative weights #6 solid line wire:
Triple Braid W.P. 112 lbs. per 1000 ft.
Collyer Polyethylene 88 lbs. per 1000 ft.

★ **SLIMMER, TRIMMER AND LONGER LIVED**

Virtually unaffected by weathering — air, sun, water. Never festoons. Smaller diameter means less ice and wind load.

★ **FASTER TO WORK. EASIER TO SPLICE**

Strips clean in one operation.

Write today for samples and information.

Collyer INSULATED WIRE CO.
245 Roosevelt Ave., Pawtucket, R. I.

ice in this unusually hot location, it was again moved to Coachella where the climate is no cooler. Five years later, it was moved again to Gabbs, Nevada to aid the war effort in magnesium production. During all this period, the machine gave satisfactory operation—many times at a 25% overload, and much of the time at practically the highest ambient temperatures in the whole United States.

Machines now in use with original Class A windings total seven, averaging 29.4 yr age. At least four of these windings are known to be near the final stages of existence. Two machines having their original Class A-B insulation are in use with an average age of 24 yr. Four machines having original full Class B insulation are represented at an average of 23.5 yr each.

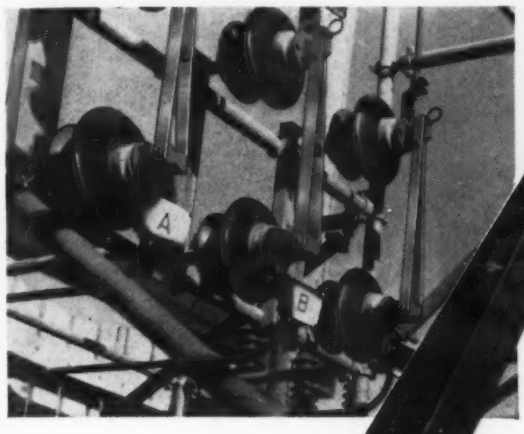
From an inspection of the foregoing record, it is evident that the choice for practically all of the more recent winding replacements has been Class B. With the present trend of cost of new windings, it is necessary to balance all factors very carefully. In one instance, a Class B winding, purchased in 1946, cost $1,200 more than the entire generator unit twenty years earlier. The experience of the California Electric Power Co indicates that the added expense of Class B over Class A for windings of rotating machines is generally justifiable.

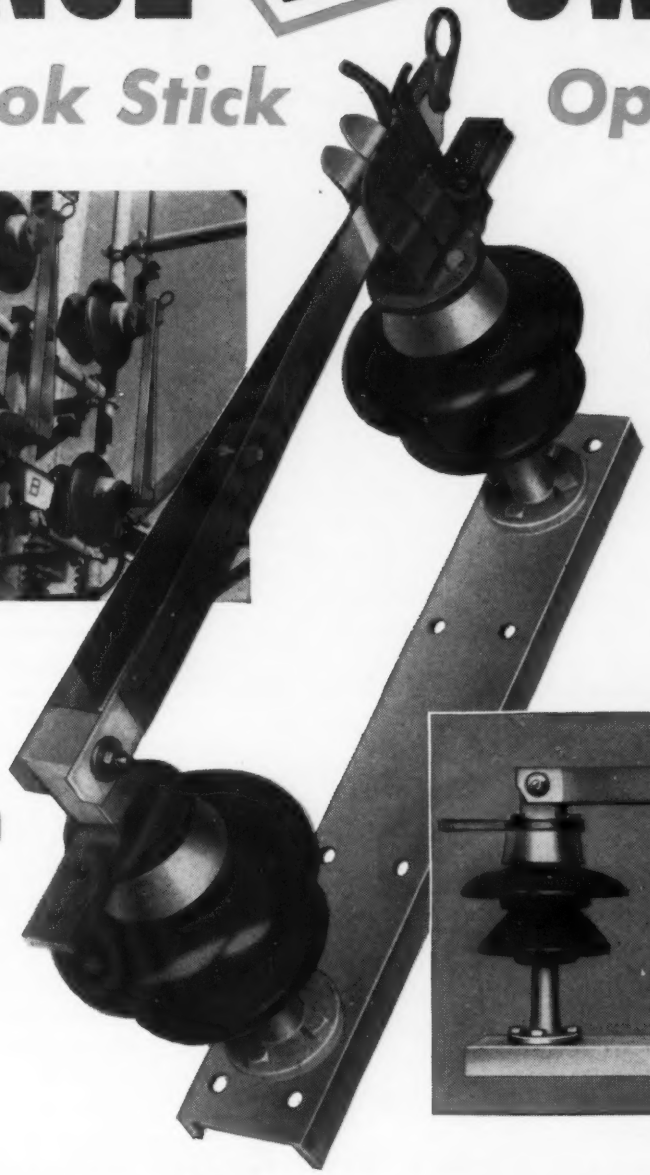
Organized Tree Trimming Analyzed

EXPERIENCE WITH tree trimming was analyzed by a power company during the recent war on the basis of wires down per 10,000 trees. The system averaged 5.8 such troubles over a 6-year period. This was equivalent to 7 troubles per year per 100 miles of line. Data showed that with annual trimming the average was 4.9 wires down per 10,000 trees. During the second year of a 2-year trimming cycle this rose to 6.5. There was an obtainable reduction of 0.8 trouble per 10,000 trees per year by reducing the 2-year period to an annual one. The conclusion was that under the prevailing conditions the extra cost of yearly trimming 10,000 trees to prevent this small amount of trouble would not be justified. The method of analysis was considered significant as an economic approach

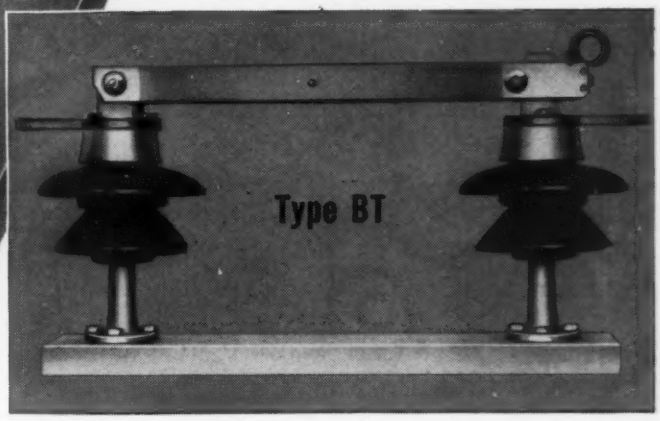
CHANCE Type BN-BT Switches*

Hook Stick Operated





Type BN



Type BT

For all types of Single Pole Installations

400 to 2000 Amp.
7.5 to 161 Kv.

Chance Hook Stick Operated Disconnecting Switches are made in a complete range of capacities in all voltages up to and including 161 Kv. They are available in single or double throw types for horizontal mountings—upright or underhung, and for vertical mounting up to 115 Kv.

● Sturdy Construction . . . High Conductivity
Chance BN and BT switches are ruggedly built throughout. Trussed blades add rigidity. All current carrying parts are constructed of high conductivity copper.

● Positive Blade Latches
Spring latches secure the blades in the contact clips and prevent opening under short circuits.

● Self-Aligning Clips
Contact clips on the BN switch are of the spring type which make positive contact even though blade may be slightly out of line. Tapered tongue on BT type guides blade to proper position—contact pressure is adjustable.

● Long Life Contacts
Silver surfaced area contacts are provided for long life.

* CHANCE SWITCHES (FORMERLY BOWIE) ARE BACKED BY 42 YEARS OF SWITCH ENGINEERING AND MANUFACTURING EXPERIENCE.

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A chain is only as strong as its weakest link. Prevent weak links in your product by using ILLINOIS bushings produced to meet your engineers' most exacting specifications.

ILLINOIS' thorough control of production methods results in the manufacture of porcelain bushings of high dielectric and great mechanical strength, with the utmost in dimensional accuracy. Careful kiln drying and firing, at constant temperatures, prevent internal stress.

These bushings can be standard glaze or radio interference-proof glaze. Dry type bushings are produced for all voltages up to 34.5 kv. Gasket seats are smooth and ground when required.

★

Complete Uniformity
Exact Dimensions
High Dielectric Strength
High Mechanical Strength

★

Specify Illinois Porcelain
for Dependability and Economy

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to cost evaluation by the utility.

On this system trimming was mainly done by a group of expert tree trimming companies. In one exceptional municipality, employees of the tree companies worked with the utility crews. Here the tree specialists were not permitted in direct charge of such work. In three other towns, utility crews trimmed when regular line work was slack.

Contact With Wardens

It was the policy of the utility to maintain contact with tree wardens, especially at the start of a trimming program. Representatives of the tree trimming companies, however, were often welcomed at such conferences. Joint trimming with the telephone people was widely practised. Responsibilities and costs were shared in proportion to the work done for each utility.

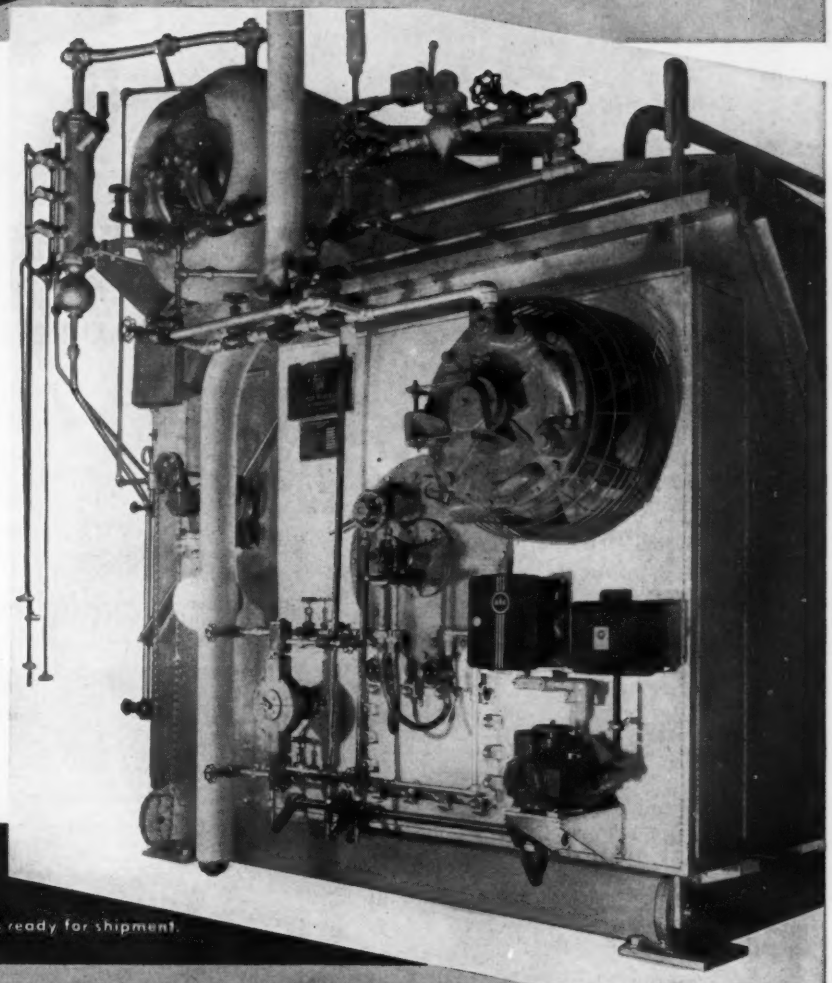
Defects such as slack wires, need for tree wire, broken pins, etc., were noted by all tree crews and reported to the power company. Urgent cases were reported immediately, others being submitted with the time slips. Practice varied as to the use of inspectors employed by the company to follow tree crews and report defects for correction. In some areas this plan was considered best, as the tree men were not considered sufficiently familiar with overhead wire facilities to detect all faults. In all cases, a light line crew later covered the areas trimmed and corrected the defects reported or noticed. In general, it did not prove economical for a line crew to work with the trimming crew to take care of wire defects. The defects found did not provide enough work to occupy a crew continuously.

Trimming Schedules

Schedules for tree trimming were based fundamentally on the rate of growth. Experience indicated that the trimming clearance generally obtainable from municipal tree wardens was nearly equal to two years' growth. This led to the adoption of a 2-year schedule for most areas. In cases where the wardens were less liberal as to clearance and only one year's growth was obtainable, annual trimming was standard. In one other municipality the tree experts advised an annual trim because of the generally poor condition of trees. These were failing rapidly due to moth, paving and soft wood species.

The NEW Foster Wheeler Package Steam Generator is...

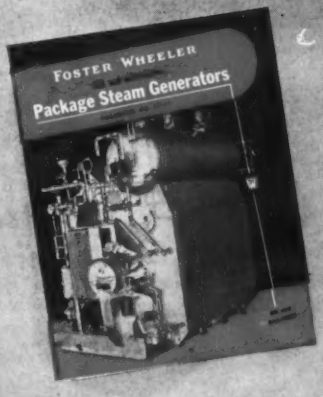
FACTORY ASSEMBLED --READY TO INSTALL



This AG 21-0 package steam generator 21,000 lb. per hour steam capacity, as shown here, is ready for shipment.

The name "package" applied to these steam generators means that all components, including burners, fans, soot blowers, feedwater regulators, combustion controls, valves, refractory, insulation and other accessories, are assembled in one package at the factory. The local labor necessary for installing this package is limited to service connections.

FOSTER WHEELER CORPORATION
165 Broadway, New York 6, N.Y.



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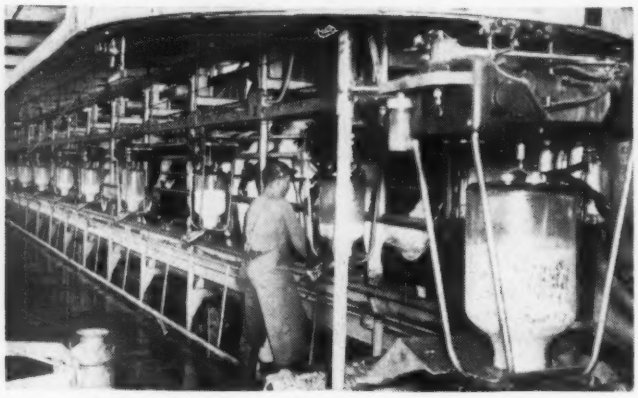
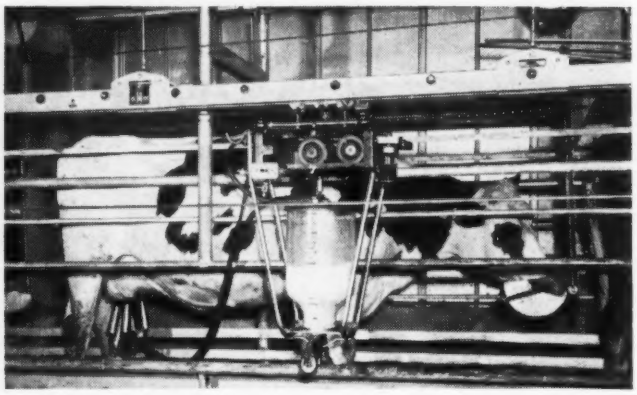
FURTHER INFORMATION
WRITE FOR
BULLETIN PG-47-17

FOSTER WHEELER

LOAD BUILDING



CONVEYOR SYSTEM used by western dairy for milking cows has proved faster and more efficient than conventional system



COW AND MILKING MACHINE are both carried along together by the conveyor. Cows can feed from trough during milking operation

Cow Conveyor Speeds Milking

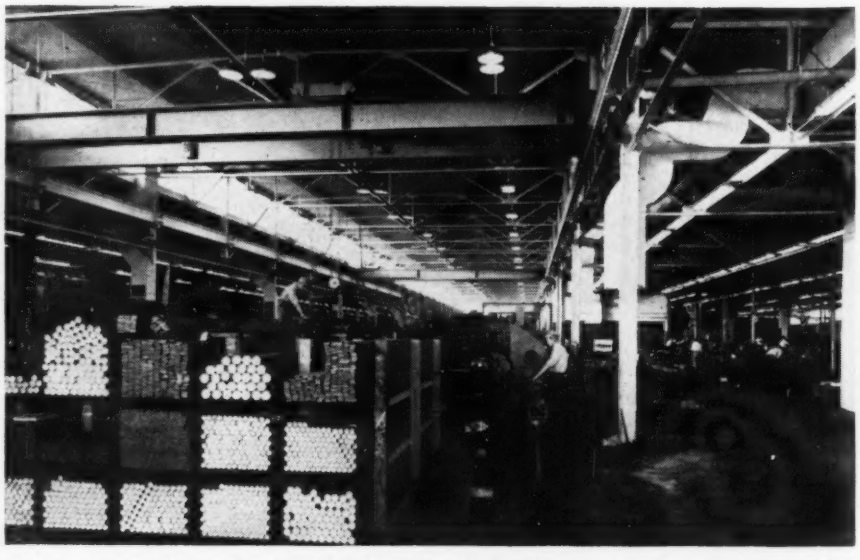
A COW MILKING conveyor system that substantially reduces manpower and equipment required to handle a large herd has been used for more than a year at the Hiett Crystal Dairy, Delano, Calif. By eliminating carrying of the containers back and forth and time lost in moving cows in and out of stalls the system has speeded up production. Four men—a yard man, washer, and one at each end of the line—milk 218 cows in 2½ hours. This is an average of about 42 sec per cow.

The system uses an endless conveyor to move the cows and 12 trolley-suspended milkers to do the milking. Power for the conveyor, which moves the milking machines along with it, is furnished by a 5-hp gear-reducer motor. The milking machines are each driven by ¼-hp, single-phase motors fed from a 120-volt enclosed trolley that extends the length of the conveyor.

As the cows enter the conveyor they are washed and the milking machine attached and started. After an unhurried trip down the line, during which they can feed from a small trough before them, the cows are released by a gate that opens automatically as the milking machine is removed.

Milk is emptied automatically from the container and piped to the milk room. The milking machine returns to the end of the line and is ready to go again. An added feature of the system is its crowd appeal—as many as 200 spectators in this small town have watched the milking on a Sunday afternoon.

Better Lighting For New Manufacturing Plant



HIGH- AND LOW-BAY LIGHTING provide 35 to 100 ft-c in various segments of this Ohio electric motor manufacturing plant. High bay in center is lighted with a combination of mercury and incandescent units. Low bays on either side are lighted with 3-lamp industrial luminaires in rows

ILLUMINATION LEVELS ranging from 35 ft-c in storage areas to 100 ft-c in inspection areas are maintained at the new Ashtabula, Ohio, electric motor manufacturing plant of the Reliance Electric & Engineering Co. Flexible mountings permit the spacing between lighting fixtures to be

Discarded

ANTIQUES

belong in the cellar

...but not

CIRCUIT PROTECTION

The cellar's a good place for a furnace—and for storing furniture, preserves, and last summer's hammock — but not the best place for circuit protection devices. Today's architects and electrical contractors prefer installing protection on the same floor as the loads. Simple, safe, good-looking Federal NOARK Multi-Breakers are placed where they're accessible *instantly* for instant restoration of light or appliance circuits. A full range of ampere ratings is available for indoor and outdoor applications.

Write for a copy of the "FEDERALOG". address Dept. W

NEW! TYPE MO-4 MAGNETIC THERMAL MULTI-BREAKER

Federal

NOARK *Multi-breakers*

Executive Offices: 50 Paris Street, Newark 5, N. J. Plants: Hartford, Conn., Newark, N. J., St. Louis, Mo., Long Island City, N. Y.

Federal Electric Products Company, Manufacturers of a Complete Line of Electrical Products Including Motor Controls • Safety Switches • Service Equipment Circuit Breakers • Panelboards • Switchboards • Bus Duct

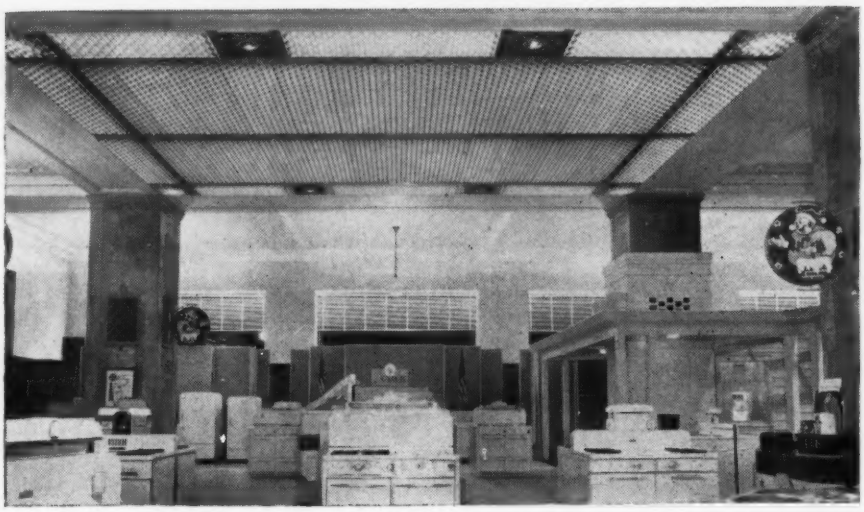
SALES OFFICES IN PRINCIPAL CITIES

changed to secure levels of from 50 to 75 ft-c in certain departments where extremely close precision work normally demands exceptionally high visibility.

Low bays are lighted by continuous runs of three-lamp 40-w standard industrial luminaires on 16-ft centers installed 15 ft above floor. High bays have twin 400-w mercury and 500-w incandescent medium-spread porcelain-enamel units mounted 24-ft high and on 17-by 20-ft spacing.

Above Truss Line

Lighting equipment has been located above the truss line in all cases to assure uninterrupted use of the space between floor and trusses. A 33⅓% decrease in efficiency is allowed over a six-month period to take care of decreases in lamp output and grime accumulation.



LOCAL INTEREST IN OVERALL CEILING LIGHTING is being stirred up by a demonstration installation in the sales room of the Rochester (N.Y.) Gas & Electric Corp. Anodized aluminum louvers in sections 8 ft long, 2 ft wide fill in a 21 by 30-ft bay formed by ceiling beams. In the 1-ft deep recess above the louvers are installed 78 8-ft and 12 6-ft Slimline lamps. Including ballast losses, the connected load is 6.7 w per sq ft. Maintained intensity is designed to be 100 ft-c. For accent lighting, 4 directable 150-w spots are installed in pairs on 2 sides of the panel

Ball Cage Lighting Serves Varied Uses

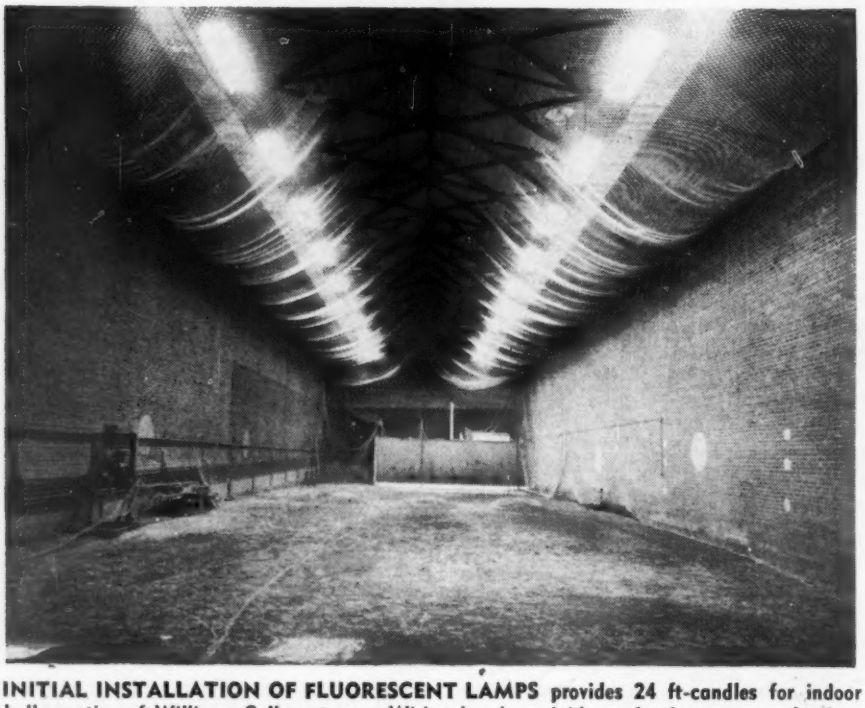
RALPH A. POTTER
Northern Berkshire Gas Co
No. Adams, Mass.

NEW ENGLAND COLLEGES are showing much interest in a new lighting installation at Williams for baseball practice. Williams College (Williamstown, Mass.) has maintained an indoor cage for this purpose for some time. The former installation employed six 200-w lamps, supplemented by a skylight. This was tolerably good, but when the roof was repaired recently the skylight was replaced by solid construction. Under the direction of Charles Mills, chief engineer of the college, an improved layout was made. The revised installation has 24 industrial-type fixtures, each equipped with two 200-watt white lamps (235 w per unit). Connected load is 5.6 kw and the present monthly bill is about $15.

The cage is 140 ft x 40 ft x 30 ft high. Walls of red brick were left unchanged in color to insure better visibility of white baseballs. The mounting height of the fixtures is 22 ft. At present each of the two rows (22 ft apart) has been installed with a 5-ft space between fixtures. Later it is expected that the rows will be made continuous, raising the number of lighting units to 46. When this is done the intensity of illumination will be increased to about 46 ft-c.

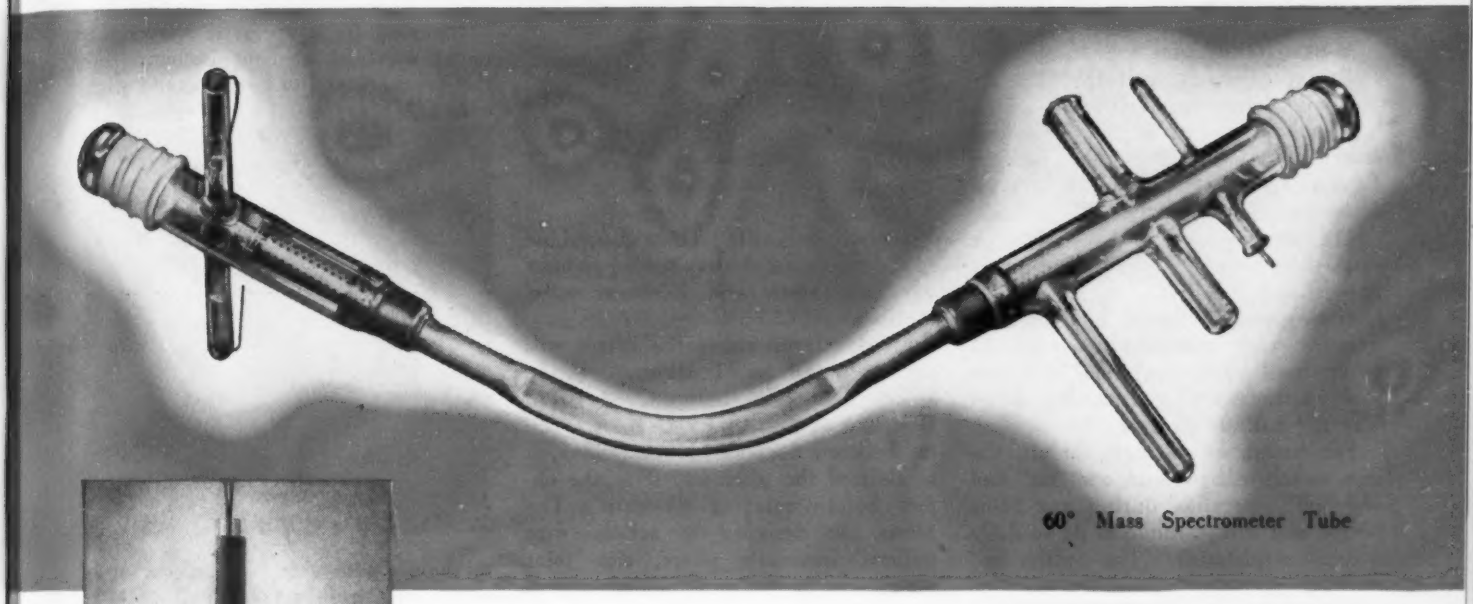
Each fixture is separately wired. The new installation called for a new service entrance, 12-circuit panel and is provided with catwalk facilities for maintenance. A block and tackle are used for raising the fixtures, and a permanent ladder, was installed for catwalk access. Fixtures can be replaced without interrupting practice. Watchdog starters prevent the blinking of old lamps.

Although the cage was originally planned for baseball, it has lately been used for lacrosse, shotput and highjump practice. The tennis team will use it next winter.

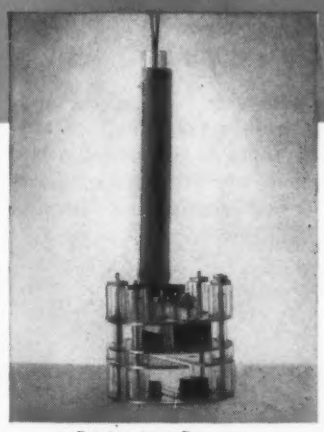


INITIAL INSTALLATION OF FLUORESCENT LAMPS provides 24 ft-candles for indoor ball practice of Williams College team. Wiring has been laid out for future rows of tubes.

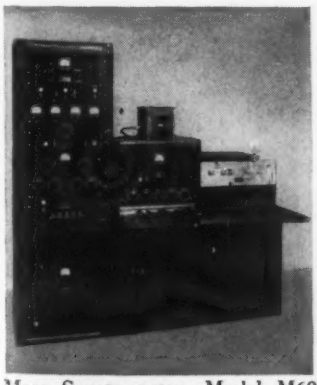
URANIUM U-235 detector employs NICHROME* V exclusively



60° Mass Spectrometer Tube



Ionization Source



Mass Spectrometer—Model M60
(Process & Instruments,
Brooklyn, N. Y.)

THE Mass Spectrometer, which has played vital roles in the discovery of U-235 and its subsequent applications in fields of atomic energy and cancer research, is one of the most important measuring instruments of the modern age. Its ability to crack molecules and then sort them according to mass makes it unique for analytical purposes.

Materials entering into its construction must be superlatively stable, assuring the highest degree of accuracy at all times, and retain their characteristics unfailingly throughout a long life of trouble-free service.

Specifications for the metal used in the Ionization Source and Collector System typify the super-critical requirements that have to be met. The metal must be:

(a) non-magnetic (i.e. remain unmagnetized in the presence of the powerful magnet used in the Mass Spectrometer);

(b) able to withstand temperatures of approximately 665°F. in a vacuum of 10^{-7} mm. mercury *without deformation or evaporation;*

(c) non-porous, and non-absorbent of gases;

(d) easily machined, drilled, tapped, threaded, and spot welded;

(e) available in wire, sheet and rod forms.

"Of all available metals" states Process & Instruments Inc., of Brooklyn, N. Y., makers of Mass Spectrometers, "Nichrome V most satisfactorily meets all these requirements and hence, with the exception of the tungsten filament, is exclusively used by us in the construction of the Mass Spectrometer. In addition, a Nichrome heating element is used for outgassing the Spectrometer Tube of absorbed moisture".

If *you* have particularly exacting specifications to meet, consult with us. There are more than 80 Driver-Harris alloys specifically designed to fill the requirements of the Electrical and Electronic Industries. The fruits of our 48 years of specialized research experience are at your service.

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BRANCHES: Chicago, Detroit, Cleveland, Los Angeles, San Francisco, Seattle
Manufactured and sold in Canada by
The B. GREENING WIRE COMPANY, LTD., Hamilton, Ontario, Canada

*T.M. Reg. U. S. Pat. Off.

NEW EQUIPMENT

Time Switch

A NEW HANDY time switch, operated by a synchronous, self-starting, permanently lubricated Telechron motor, has been announced by the Meter and Instrument Divisions of the General Electric Co. This type T-47 is rated 35 amp at 115 and 230 v.

The new switch is applicable on farms (for regulating lights in poultry houses and brooders), in stores (for operating window lights) and small industries (for controlling ovens and other small equipment), and in homes and apartments (for operating driveway and hallway lighting).

For timing of a single circuit, the new switch will perform one "on" and one "off" operation during any 24-hr period and will continue to do so daily without adjustment. The switch has

a spst mechanism with silver, snap-action contacts. It is equipped with a large 24-hr clock dial easily read and adjusted.

Switch-tripping operation can be manual or automatic. The switching cycle is resumed automatically after the hand operation is completed.

•

Combination Pliers

PLIERS WHICH lock under normal hand pressure and because of a special cam action have a high cutting force, are being produced by Ross Manufacturing Co, 300 Montgomery St, San

Francisco 4, Calif. These Lock-Line pliers are made of drop-forged chrome vanadium steel with hardness rated at Rockwell C52-54.

Manufacturer states the pliers will cut 19 strand No. 1 cable, 30 penny spikes and ¼-in. bolt or rod stock. Designed to lock on a maximum 11/16 in. between deepest jaw serrations, it is claimed the plier will strip the object before relaxing its grip. The pliers are designed to act as wire pullers, lineman's pliers, slip joint pliers, wire cutter, small bolt cutter and as a locking device.

•

Photoelectric Control

FOR CONTROL of aircraft obstruction lights on smoke stacks, towers and other high structures, a photoelectric light control has been made available by Fisher-Pierce Co, 72 Ceylon St, Boston 21, Mass. The controls turn on automatically at 35 ft-c and turn off at 55 ft-c. Model 61305 is rated to control 500 w of incandescent lamp load. Model 61306 is rated to control 3000 w. Both operate at 120 v, 50 to 60 cycles.

A fail-safe feature is included to keep the light turned on in case of a functional failure. A time delay of 15 sec is incorporated in the circuit to prevent its being turned off at night by lighting or any passing lights or beams that focus on it momentarily.

•

Midget Circuit Breaker

A PALM-SIZED circuit breaker has been produced that is said to interrupt 5000 amp at 125 v a-c and withstand a mechanical impact up to approximately 150 ft-lb. The breaker, 3 in. long by 2-⅛ in. deep by 1 in. wide, is available from Westinghouse Electric Corp, P. O. Box 1017, Pittsburgh 30, Pa. It is suitable for use on transit systems, some marine applications, and similar places where vibration is prevalent.

Damping by a specially shaped bimetal overload element accounts for the breakers ability to withstand high

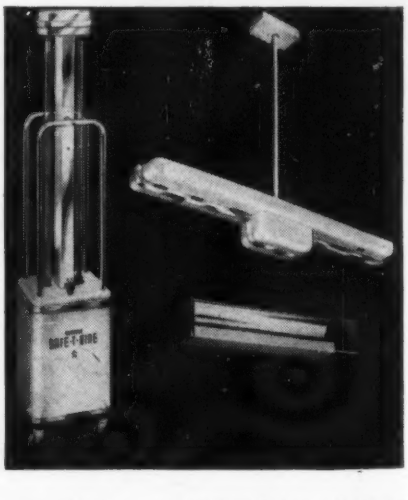
mechanical impacts. Using the over center principle in the circuit breaker mechanism; contacts of special alloy; and a "De-ion" arc extinguisher, make possible a fast acting breaker with small contact separation. The breaker is arranged for front-of-panel or rear-of-panel mounting.

•

Germicidal Units

A GROUP of Safe-T-Aire fixtures has been designed by the Hanovia Chemical & Mfg Co, Chestnut St & N.J.R.R. Av, Newark 5, N. J. All standards units are for operation on 110-120 v, 60 cycles.

The ST2832 is a ceiling suspension unit to provide indirect irradiation to the upper air. Various types of burners

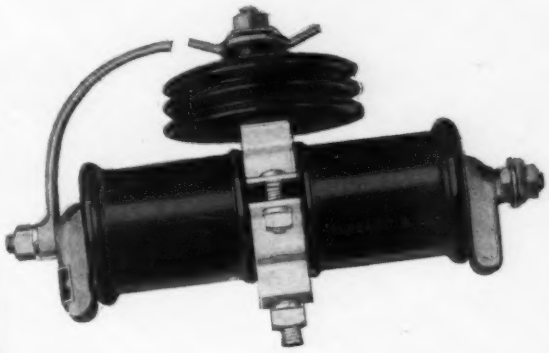


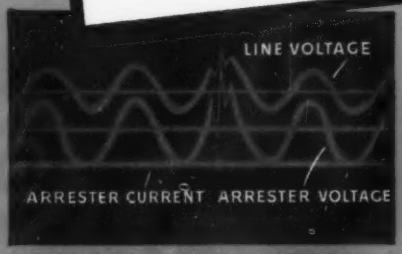
CHEAP WORKING INSURANCE WITH HUBBARD AUTOGAP

Hubbard Autogaps

are furnished in three sizes with maximum arrester voltage ratings of 3000 V., 6000 V. and 9000 V. Also furnished with drop-out fuses. Attachment Brackets are available for transformer, pole or arm without extra cost. Specify type of mounting desired.

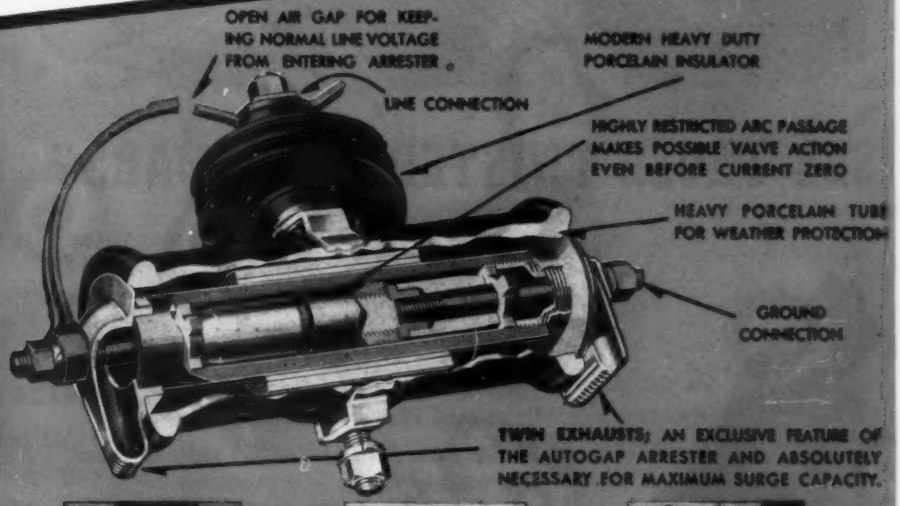
The cut-away drawing and oscillograms show the construction and operation of the Hubbard Autogap principle. Years of service in the field, with no failures, is the achievement of the Autogap, the most outstanding Lightning Arrester ever built.





OSCILLOGRAM•TYPICAL OPERATION

ACTUAL OSCILLOGRAM•SURGE CURRENT

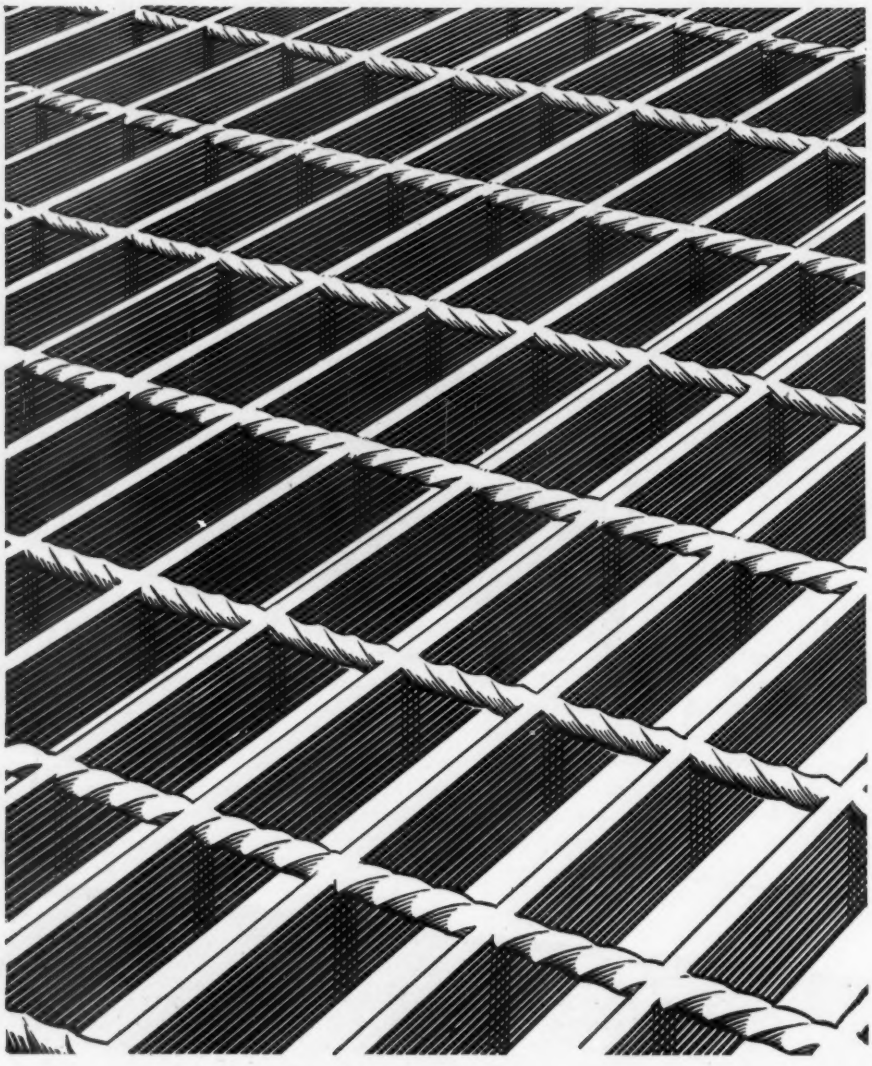

OPEN AIR GAP FOR KEEPING NORMAL LINE VOLTAGE FROM ENTERING ARRESTER
MODERN HEAVY DUTY PORCELAIN INSULATOR
LINE CONNECTION
HIGHLY RESTRICTED ARC PASSAGE MAKES POSSIBLE VALVE ACTION EVEN BEFORE CURRENT ZERO
HEAVY PORCELAIN TUBE FOR WEATHER PROTECTION
GROUND CONNECTION
TWIN EXHAUSTS; AN EXCLUSIVE FEATURE OF THE AUTOGAP ARRESTER AND ABSOLUTELY NECESSARY FOR MAXIMUM SURGE CAPACITY.

MOUNTINGS

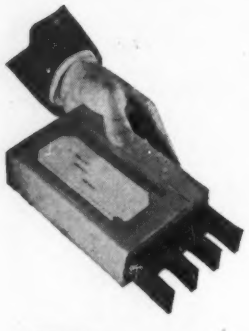
HUBBARD AND COMPANY

Pittsburgh *Chicago*

Oakland, California



SEE THOSE TWISTED CROSS-BARS?



They're electroforged directly *into* the bearing bars to form a rigid one-piece steel "material" of guaranteed strength—with safe footing at all times . . . Blaw-Knox Grating also—

- ★ *Provides Maximum Open Area* for light and ventilation
- ★ *Is Easy to Maintain* . . . easy to paint thoroughly
- ★ *Is Self-Cleaning*—no sharp angles to retain debris
- ★ *Economical to Install* in any size or shape

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BLAW-KNOX DIVISION
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FARMERS BANK BLDG., PITTSBURGH 22, PA.

BLAW-KNOX ELECTROFORGED STEEL **GRATING**

are used depending upon requirements of each room. Bottom of fixture has two jewel windows which reflect ultraviolet light and indicate lamp is in operation. The ST2835 is a wall model with a 16-in. cold cathode burner.

The ST2830 portable floorstand model is primarily for "fumigating" vacant rooms. It is equipped with two ultraviolet lamps (2537A) and 12-ft cord on a reel in cabinet.

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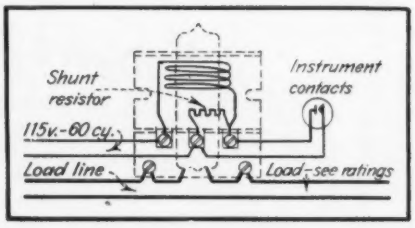


Mercury Contact Relay

MERCU-TROL relay with built-in sensitizer can be obtained from Mack Electric Devices Inc, 32 Glenside Av, Wyncote, Pa. The sensitizer is added for controlling the relay by contact-equipped instruments such as ammeters, galvanometers and thermal regulators.

Normally open or normally closed types of relays are available. They are designed to function on low control currents. Main contact is mercury to mercury make and break, and is rated 35 amp, 115 v, 60 cycle.

•

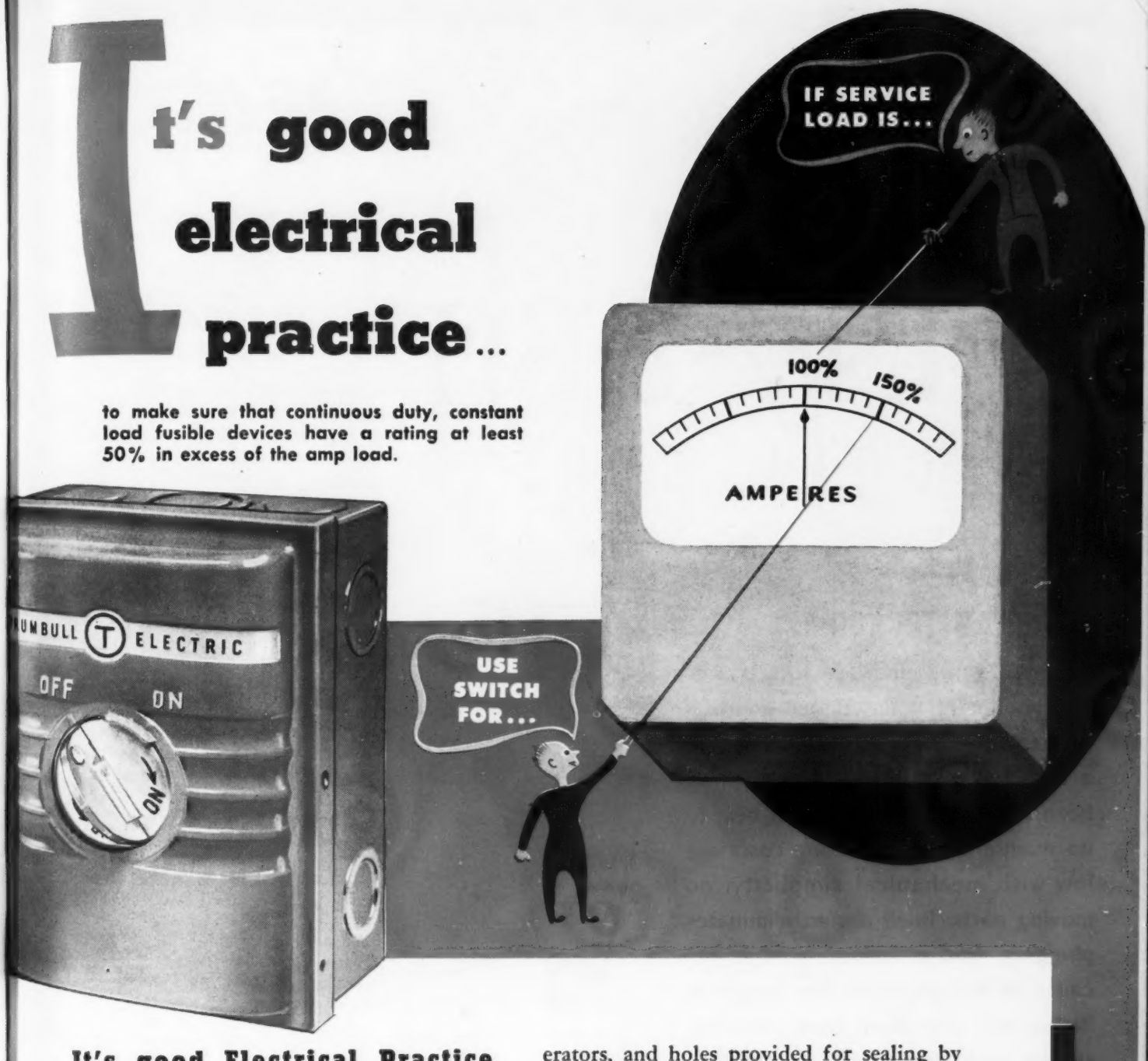
Pressure Switches

A NEW LINE of small size pressure switches has been designed primarily for use with motor-driven home water systems. Manufacturer is Cutler-Hammer, Inc, 235 North 12th St, Milwaukee 1, Wis. The switches are designed also for use with small compressors, oil pumps or any motor-driven pump on a pressure system.

One switch type has an external range adjustment for seasonal changes in pressure requirements. A second switch type has a slotted range adjust-

It's good electrical practice...

to make sure that continuous duty, constant load fusible devices have a rating at least 50% in excess of the amp load.



It's good Electrical Practice

... to use a Trumbull Type D Enclosed Safety Switch for entrance service and general purposes. Its 30 amp capacity is more than adequate for such duties as controlling small motors.

Front operated, the Trumbull Type D switch has a sturdy, *"KING-SIZE" HANDLE* . . . more than *AMPLE WIRING SPACE* . . . double break, *SILVER TO SILVER CONTACTS* under heavy pressure . . . contacts fully enclosed for protection of operators, and holes provided for sealing by power company. With its modern streamlined design, the Type D is the switch of tomorrow — *today.*

Safety switches or switchboards, motor controls or control centers, branch circuit distribution systems or main feeders . . . it's always good electrical practice to specify Trumbull, the name that safeguards *your* safe practice. THE TRUMBULL ELECTRIC MANUFACTURING CO., Plainville, Conn. Other factories and offices throughout the United States. Foreign representation.

MEN WHO OBSERVE THE BEST PRACTICES MAKE IT A PRACTICE TO USE TRUMBULL

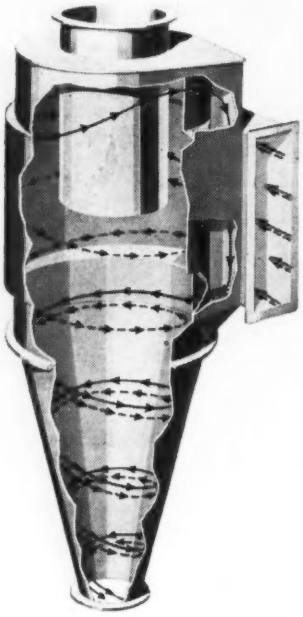
TRUMBULL (T) ELECTRIC

WHAT'S THE ACTUAL COST OF

Fly-ash COLLECTION?

Accurate reckoning

naturally must include long-range operation and maintenance costs. A good number of Buell installations, in a wide range of industrial uses, have been serving for 10 years with next to no maintenance. Operating costs are low with mechanical simplicity; no moving parts. Buell design eliminates plugging. And efficiency is high, because of the patented van Tongeren 'shave-off'. The Buell dust recovery system may mean real economy to you. Skim the facts or study the details in the new 32-page catalog. Write: Buell Engineering Company, 70 Pine Street, Suite 4900, New York 5, N. Y.

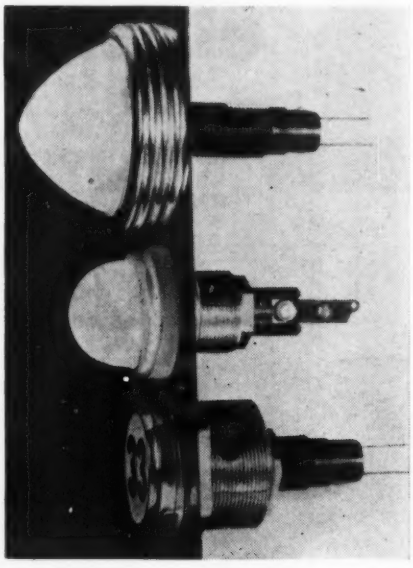


buell

Engineered Efficiency in DUST COLLECTION

ment screw and slotted differential adjustment screw inside the enclosing case for ready access. This switch is used on installations where operating conditions are uniform throughout the year. Additional information can be obtained by requesting Bulletin 10017.

•



Indicating Lamps

THREE LARGER forms of indicating lamps have been announced by H. R. Kirkland Co, 8 King St, Morristown, N. J. They use the T2 slide-base bulbs with low-current characteristics such as 0.038 amp at 6, 12 and 24 v.

The 18T2 unit features a 2-in. diam beehive glass lens and mounts in a 19/32-in. diam hole. The 59T2DE unit has a glass lens in a 1-3/8-in. diam machined metal cap and mounts in a 7/8-in. diam hole. The 6T2FL unit has a 1-1/8 in. diam flat lens available for letters or numbers and mounts in a 1-3/8-in. diam hole.

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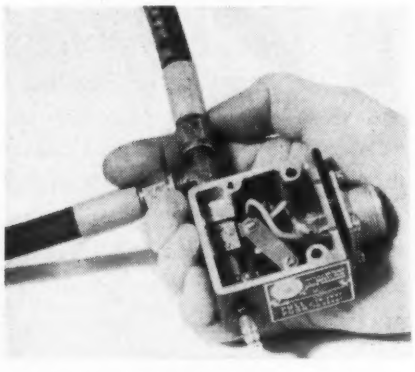
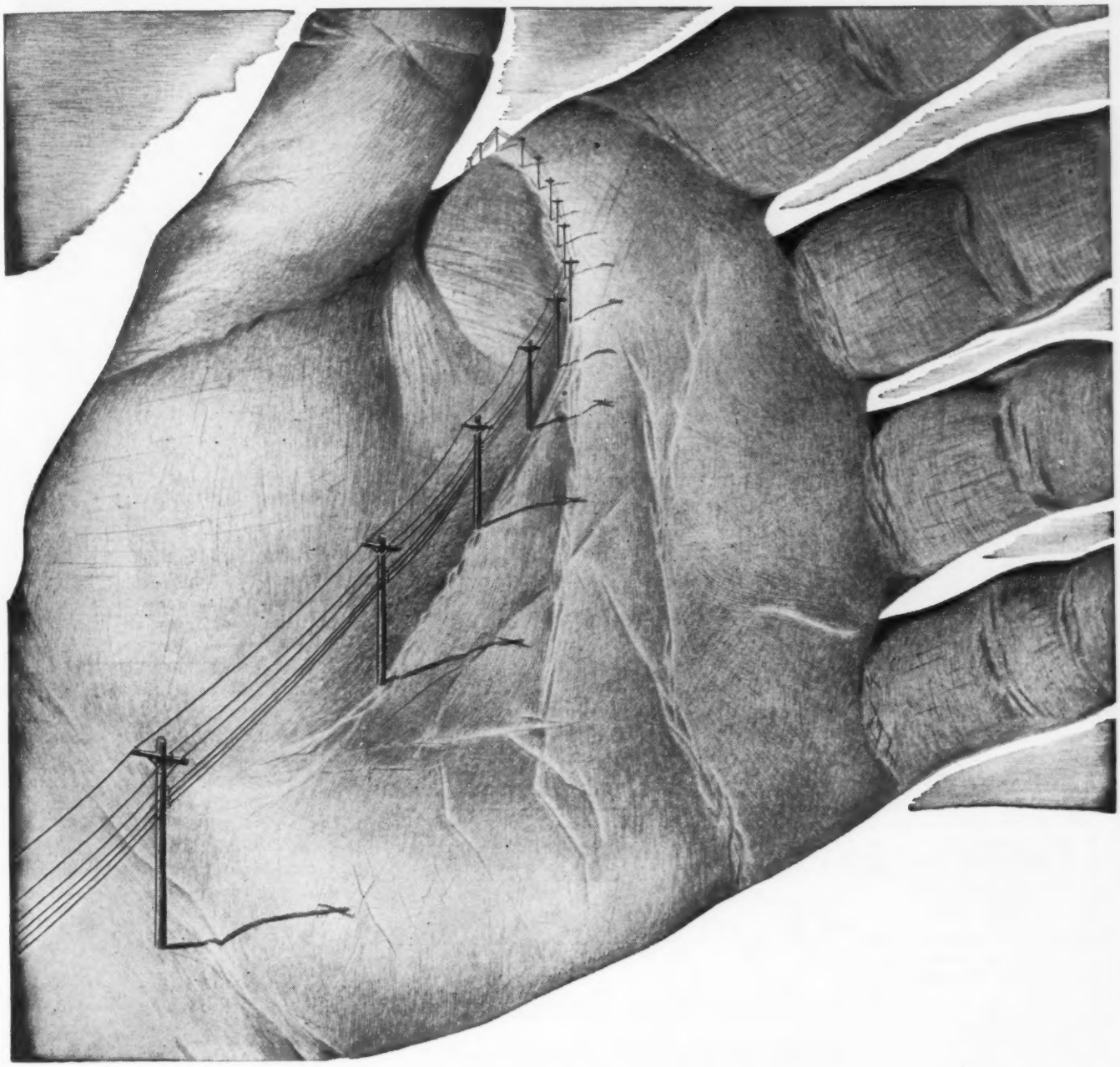


Latching Switch

FOR ELECTRICAL and mechanical indication of pressure discharges or excessive pressures, a latching switch has been developed by Consolidated Vultee Aircraft Corp. and is being manufac-



Make Duraline your Life "Line"!

MILES AND MILES of Duraline* URC weatherproof wire, up for years, have proved the superiority of this unusual weatherproof.

Duraline is designed to provide vastly improved performance during emergency periods. Interlocked felted layers, combined with URC saturants and finishers, form a fibrous sheath that effectively retards moisture penetration—even during long periods of wet weather.

Here is weatherproof that is truly *weather-resisting*. For satisfied customers—and lower maintenance costs—invest in DURALINE URC WEATHERPROOF! Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y. 48108

*Reg. U. S. Pat. Off.

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from mine to consumer

Duraline URC WEATHERPROOF

STAYS PUT!

For Uniformly Better Insulation — SPECIFY
Acme ELECTRICAL INSULATING VARNISHES

No.	Type	Viscosity cp. @ 77° F	Non-volatile % (solids content)	Film increase per coat, avg. mils	†Baking Range, conventional or infrared	Solvent	Applications
*145	Clear thermosetting	15–20	45	1.5	30 min. to 6 hrs. @ 250°–350° F.	VM & P Naphtha	Coil windings of all types, Armatures, stators, fields, transformers, frames, housings, etc. Varnishes adaptable to conventional and conveyorized systems. Apply by: Vacuum impregnation Dipping Brushing Spraying
1451	Clear thermosetting	40–50	45	2.5	18 min. to 4 hrs. @ 250°–350° F.	VM & P Naphtha	
1452	Clear thermosetting	40–50	45	2.0	30 min. to 8 hrs. @ 230°–330° F.	VM & P Naphtha	
1454	Clear thermosetting	70–100	45	3.0	12 min. to 2 hrs. @ 250°–350° F.	VM & P Naphtha	
175	Clear thermosetting	300–500	75	5.0	35 min. to 8 hrs. @ 250°–350° F.	VM & P Naphtha	
245	Black thermosetting	140–160	45	3.0	20 min. to 6 hrs. @ 250°–350° F.	VM & P Naphtha	
300	Clear air drying	40–50	45	2.5	8–10 hrs. @ room temp.	VM & P Naphtha	
1457	Clear Baking (Oxidizing-Polymerizing)	35–40	45	2.0	1–8 hrs. @ 275°–330° F.	VM & P Naphtha	
613	Black Baking & Finishing	40–50	45	3.5	1 hr. @ 260° F. 2 hrs. air dry	VM & P Naphtha	
707	Clear Spirit	5–10	25	0.8	25 min. air dry room temp.	Denatured Alcohol	

* Also supplied in 60% solids. † Baking conditions determined by equipment available, size and construction of units treated, properties required in cured varnish film, etc.

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MEMBER OF ELECTRICAL INSULATING VARNISH SECTION OF N.E.M.A.

SAFE! . . SURE! . . DEPENDABLE!

MAINTENANCE SIMPLIFIED — TRICO — COSTS REDUCED

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Safe Time-lag Renewable
Powder-Packed FUSES

Here's the fuse that's "DIFFERENT". The renewal element is custom-built and "POWDER-PACKED"—literally a fuse within a fuse.

YOU GET THESE ADVANTAGES:

- TAMPER-PROOF PROTECTION
- NON-INTERCHANGEABLE LINK
- THREE TIMES THE SERVICE
- LIFE-TIME OUTER PARTS
- LINK SUPPORT & PROTECTION

WRITE FOR BOOKLET 206-A

Speed Up Fuse Replacement With
TRICO FUSE PULLERS

Recommended by World's leading safety engineers. Handy for adjusting switch & fuse clips . . . Every electrician should carry one . . . Hang one at every switchboard.

WRITE FOR BULLETIN NO. 5

TRICO FUSE MFG. CO. — Milwaukee, Wisconsin — FUSES

tured by Airite Products Co., Los Angeles, Calif. Although designed for fire extinguishing systems on aircraft, the switch is said to be applicable in mining, oil and gas industries. It can be made to actuate at any desired pressure.

A discharge from the CO_2 supply actuates the switch and an indication by light can be made at a remote point. Dimensions are 2½x3 in. and weight is less than 6 oz. Connector plug has a lead for power, for normally closed and for normally open sides of switch. Manual reset knob has a red section which is exposed outside of the box to provide an indication that a discharge has occurred.

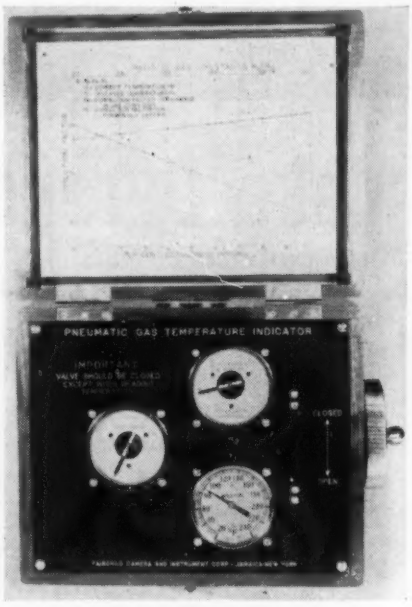
•

Louver Ceiling

NEW MODULAR "Allouver" ceiling sections manufactured by General Lighting Co, Inc, 32 Union Square New York, N. Y. are now available in 18x18 in. sections made up of either 3 in. or 1½ in. cubes. These are made of aluminum for easy handling and can be sprayed and baked to match a sample of any specific color.

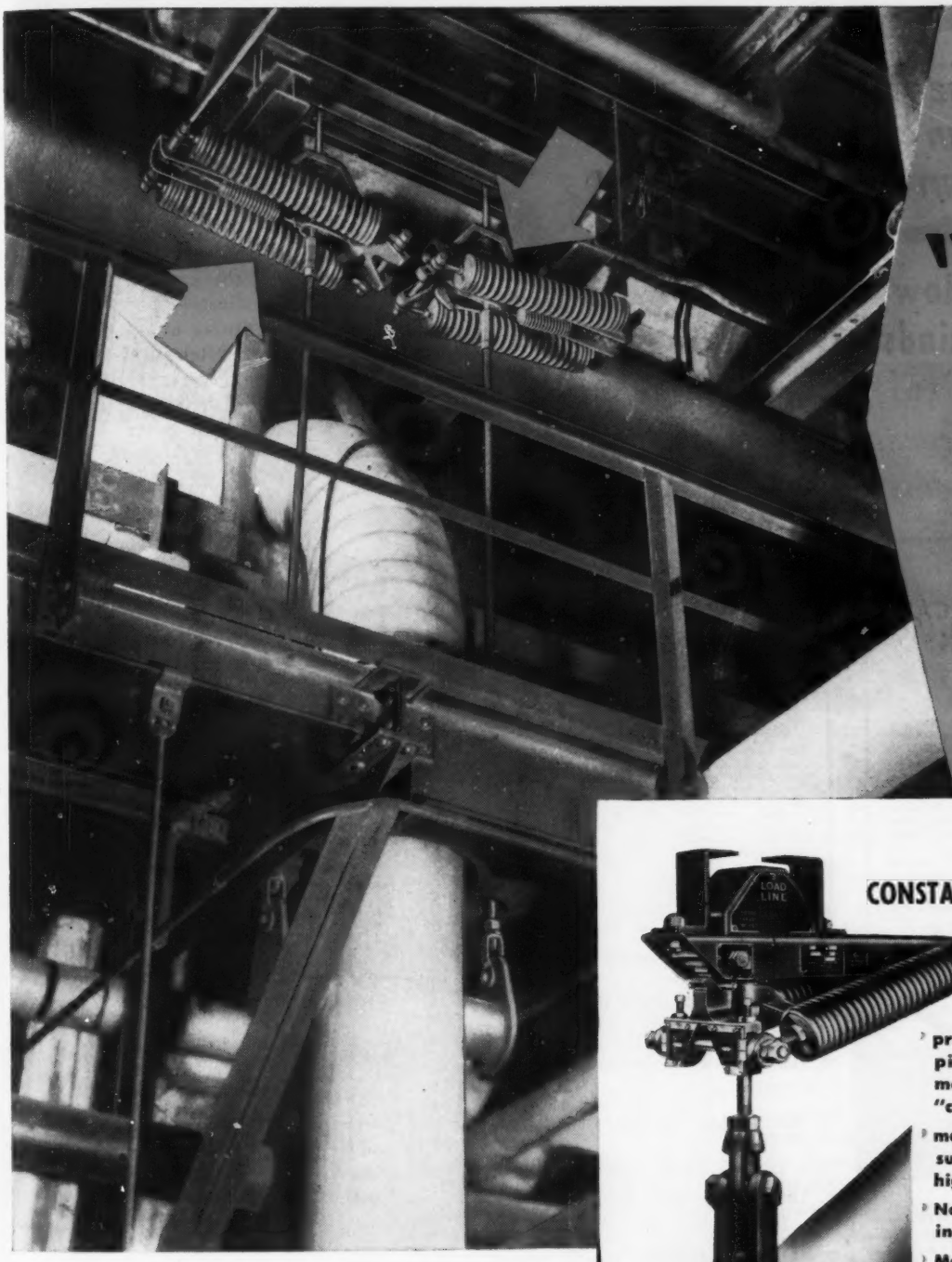
The modules are suspended by a hinged-catch mechanism on telescoping rods. Thus, a single section can be unhinged or removed without disturbing the remaining sections. When the "Allouver" ceiling is in place, it presents a complete unbroken front without a grid pattern, giving the illusion of natural daylight lighting.

•



Temperature Indicator

LABORATORY GAS temperature indicator, Unit 263, is a product of Fairchild Camera & Instrument Corp, 88-06



BIG "CAT" TAMED

with GRINNELL CONSTANT-SUPPORT HANGERS

GRINNELL CONSTANT-SUPPORT HANGER

the ONLY constant-support pipe hanger

- provides constant support to piping subject to vertical movement—in all "hot" and "cold" positions.
- maintains full safety factor in supporting high temperature, high pressure piping.
- Non-resonant, energy absorbing.
- Mass-produced from standard precision parts.
- Individually calibrated for each installation.
- Load-adjustment features incorporated into design.
- Three models meet entire range of load-travel specifications.
- Minimum headroom required.

● In one of the largest catalytic cracking plants for gasoline, Grinnell Constant-Support Hangers provide constant support for trunnion-supported vertical piping weighing 8,000 lbs. with 4" vertical movement at 1100° temperature.

Write for data book, "Grinnell Constant-Support Hangers", containing complete details.

GRINNELL COMPANY, INC.

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Branch Warehouses

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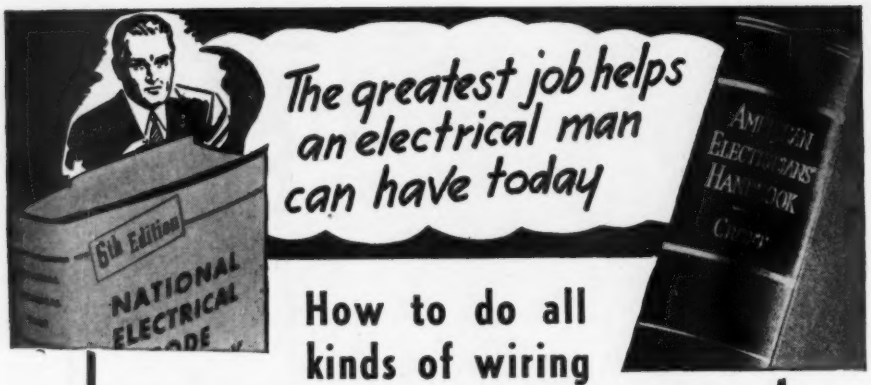
FOUNDED 1850

WHENEVER PIPING IS INVOLVED


The greatest job helps an electrical man can have today
6th Edition
NATIONAL ELECTRICAL CODE
AMERICAN ELECTRICIANS' HANDBOOK

How to do all kinds of wiring and electrical work efficiently— *in strict accordance with the latest legal requirements and best methods*

1

New 6th Edition
NATIONAL ELECTRICAL CODE HANDBOOK

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This widely used handbook helps you get electrical work done quickly and easily according to the latest National Electrical Code. Gives rules and requirements for all jobs—what they mean—how to apply them. It enables the user to understand the practical application of code requirements . . . to refer to any point quickly with assurance that no rule is being overlooked. Tells how to protect transformers from overload . . . how to install infra-red lamps . . . how to employ capacitors for power-factor correction . . . wire ranges . . . install motors . . . plus hundreds of other procedures—all explained clearly with diagrams and sketches.

2

AMERICAN ELECTRICIANS' HANDBOOK

By Terrell Croft
Consulting Engineer
Revised by Clifford C. Carr
Over 1600 pages, 400 tables, 1200 illus., $6.00

New 6th Edition JUST OUT

This book is packed from cover to cover with the right facts about practical electricity. Just revised to include the best of today's practices in the application of electronic devices, it brings you hundreds of detailed descriptions, rules, methods, pictures, and practical data to help you install, maintain and operate all kinds of electrical equipment. Contains complete data on wires and cables . . . splicing . . . capacitors . . . lighting equipment . . . electronic control of motors . . . rectifiers . . . amplidyne and rototrol control generators—every fact and procedure you need to solve day-to-day problems in installing and maintaining electrical apparatus and electronic tubes and circuits.

ELECTRICAL MACHINERY — ANNETT
CONNECTING INDUCTION MOTORS — DIDLEY
CONNECTING AND TESTING DIRECT CURRENT MACHINES — ANNETT
ARMATURE WINDING AND MOTOR REPAIR
TROUBLES OF ELECTRICAL EQUIPMENT

ELECTRICAL MAINTENANCE and REPAIR LIBRARY

5 volumes, 2042 pages, 1721 illus.

This library contains the largest collection of practical methods for electrical repair and maintenance ever put together in book form. It includes every item of information likely to be of help to the electrical maintenance man . . . everything from fundamental electrical theory to specific trouble-shooting data . . . from drawing motor winding diagrams to figuring new winding for old cores. It tells how to turn down commutators . . . how to find shorts in armature windings . . . how to inspect and repair motor starters and switches . . . how to rewire motors for different speeds and phases.

Hundreds of Helpful Diagrams

Clear, easy-to-read diagrams and photographs give you step-by-step procedures for every electrical repair operation—covering a-c and d-c motors and generators, transformers, potential regulators, rheostats, controllers, etc. In over 30 pages of trouble-shooting tables this library shows you how to diagnose troubles in electrical equipment and how to take immediate steps to correct them. Imagine getting this on-the-job help for only a few cents per day! Check the free-trial easy-payment offer in coupon at right, and send for your set today.

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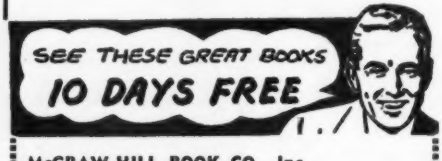

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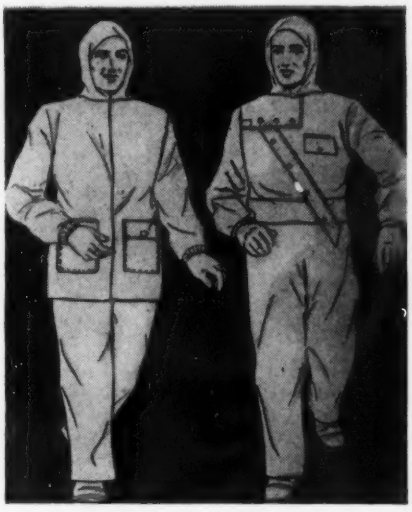
Van Wyck Blvd., Jamaica 1, N. Y. It is designed for gas turbines, turbo jets, ram jets and general industrial laboratory use. In the measurement of gas temperatures, accuracy is reported to be 1% up to 2000 F and reproducibility of plus or minus 2% in the 2000-5000 F range.

System used in the instrument is a form of gas thermometer and utilizes the density of the gas being measured as a direct indication of temperature. Temperature probes of suitable metals are furnished for temperature to 2300 F. Water-cooled probes with iridium orifices are furnished for temperatures to 5000 F. Probe diameter, length and shape are tailored to customer specifications.

•



Utility Rain Suits

ONE-PIECE and two-piece styles of garments offer protection in rain, snow and sleet. The garments are obtainable from Industrial Products Co, 2808 North Fourth St, Philadelphia 33, Pa. They are patterned roomy to be worn over regular clothing.

Double texture fabric has a sheet of solid rubber vulcanized in between. Color is olive drab. Sizes range 36 to 50.

•

Liquid Level Control

A NEW FLOATLESS level control consists of an electric relay operating from a probe circuit through a transformer and a rectifier. This control is a product of Photoswitch Inc, 77 Broadway, Cambridge 42, Mass.

Type 10CB1 is designed to control the level of practically all electrically conductive liquids. Only stainless steel probe rods are located in the liquid. The probe circuit may be set at several different sensitivities. As a result it will discriminate between a liquid and

preserve wood with SANTOPHEN 20

By assuring long-lasting, dependable protection to industry's huge investments in wood, Santophen 20 contributes much to the nation's economy. It controls termites, wood-boring insects, rot and fungus growths —protects and preserves poles, cross arms, ties, timbers, guard rails, bridge decking, loading platforms and other similar types of heavy wood construction.

Santophen 20 is Monsanto's pentachlorophenol. Its proved killing power never varies, because its chemical characteristics are always laboratory controlled, always exactly duplicated. This constant dependability is one of the most important factors to consider in wood preservation.

For complete application and formulating data on Santophen 20, ask for a copy of Monsanto's book, "Wood Preservation with Santophen 20 in Oil Solutions by Pressure Processes." Write to MONSANTO CHEMICAL COMPANY, Organic Chemicals Division, 1700 South Second Street, St. Louis 4, Missouri, or simply return the coupon. *Santophen: Reg. U. S. Pat. Off.*

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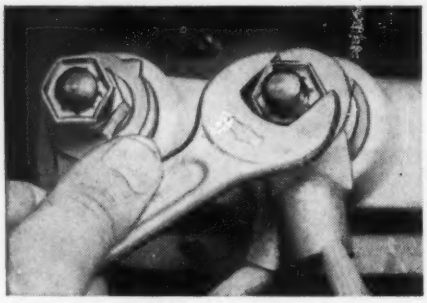
SERVING INDUSTRY . . . WHICH SERVES MANKIND

PALNUTS Keep Terminal connections Permanently Tight



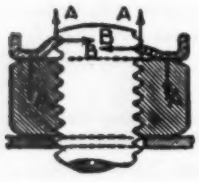
- *Perfect Conductivity*
- *No heating or corroding of contact surfaces*
- *Easy, speedy assembly*

"Palnuts" apply on TOP of the regular nuts, holding them to original tightness. Spring washers are eliminated between nut and terminal lug. There can be no backing off of nuts, nor opened spring washers to reduce contact. Instead, full conductivity of the entire nut seat is maintained under severest vibration.

Double-locking "Palnuts" are single thread locknuts, made of tempered spring steel or Duronze. They are easily, quickly spun on with the fingers and locked with 1/3 turn of a wrench. Require only 3 bolt threads space, are light in weight, low in cost, may be re-used.

"Palnuts" are available from stock for every utility requirement. Write for "Palnut" Manual giving engineering data.

Double Locking Action

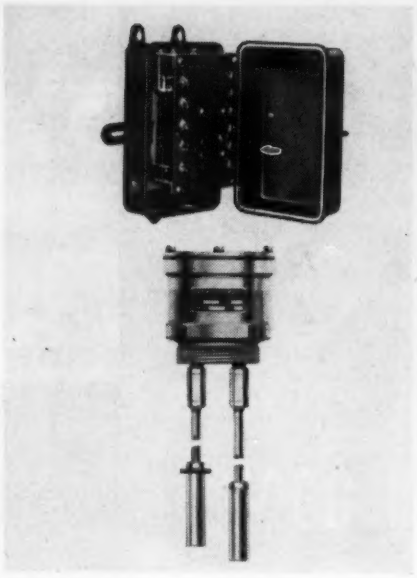


Arched, slotted jaws grip the bolt like a chuck (B-B), while spring tension is exerted upward on the bolt threads and downward on the regular nut (A-A), securely locking both.

THE PALNUT COMPANY

51 Cordier St.,
Irvington 11,
N. J.

DOUBLE-LOCKING
PALNUTS
Trademark Reg U S Pat Off



its foam. This circuit will operate from a resistance as high as 3500 ohms it is reported.

The spdt relay has contacts rated 2 amp 115 v or 1 amp 230 v a-c and furnished with arc suppressors. Power consumption is 0.5 w on 115 or 230 v, 60 cycles.

•

Thermocouple

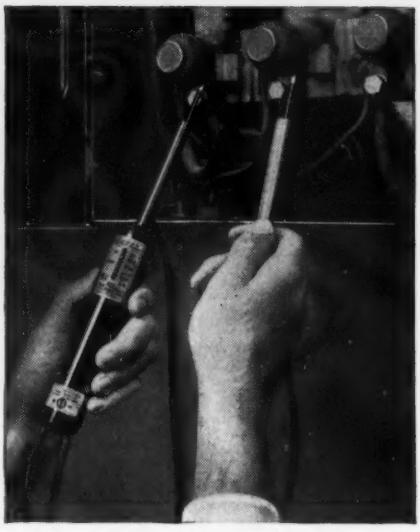
A NEW THERMOCOUPLE for gas turbines, which is reported to combine a high rate of response, has been announced by Manning, Maxwell & Moore, Inc, Bridgeport, Conn. Sensitive portion consists of chromel tubing into which is inserted and welded alumel wire.

Time constants of better than 1.2 sec are measured at gas velocities of 250 fps, with a life expectancy of 200 hr at 1600 F. Inconel sheath, lead wire protected by stainless steel braid and chromel alumel AN terminals are standard.

•

Pantograph Engraver

AN ENGRAVER suitable for tasks of both 2 and 3-character is being produced by Mico Instruments Co, 80 Trowbridge St, Cambridge 38, Mass.



Knopp Voltage Tester

with PROD-MOUNT

is Easier to Use, has 5 SAFETY FEATURES

- **Neon Light**
- **Easy-Reading Scale**
- **Hums on a-c and pulsating d-c**
- **Prod-Mount**
- **Fully-Insulated Prods**

The Knopp Voltage Tester, a professional tool, has an exclusive prod-mounting socket in its housing, making this tester easier, faster, and safer to use.

It tells immediately and simply, without fuss or bother, if circuit is open or closed, magnitude of voltage between 110 and 600, whether a-c or d-c, pure or rectified, whether 25 or 60 cycles—for testing old or new circuits, fuses, locating grounds, open phases, etc.

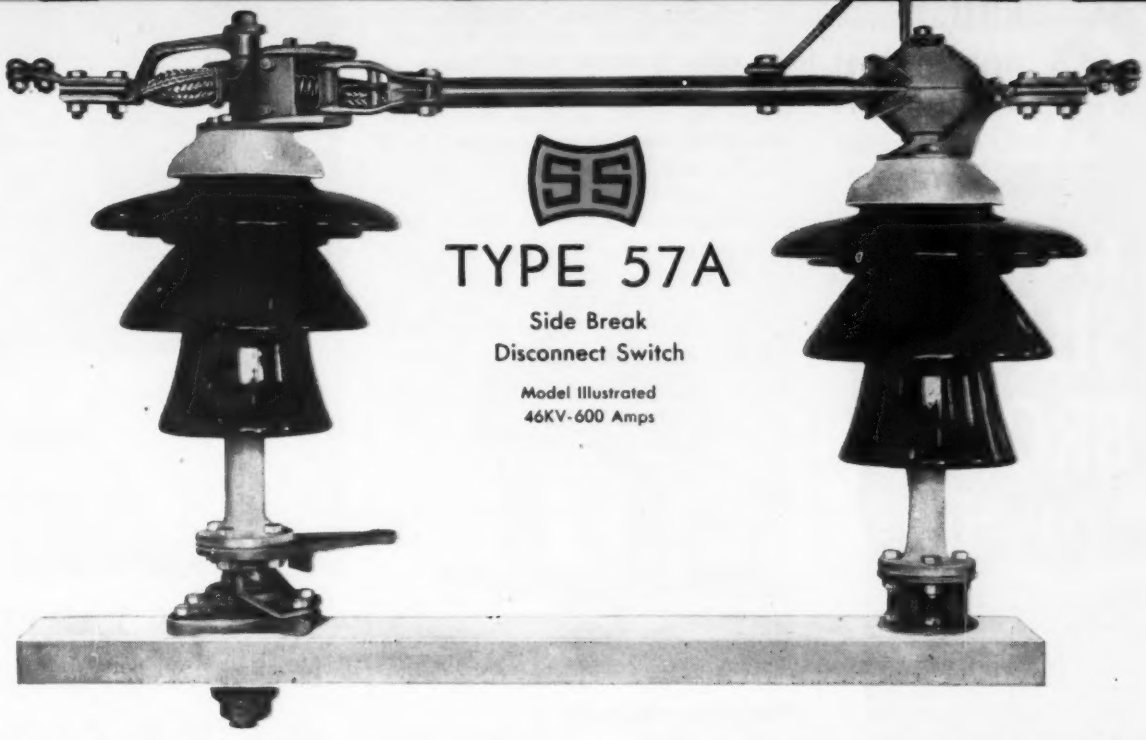
Well built in a strong, round, laminated bakelite housing, the solenoid-type shock-proof Knopp Voltage Tester has 5 main safety features: prod-mount, neon lamp that works independently of solenoid for dual indication, quick scale reading, hums on a-c and pulsating d-c, and is properly insulated throughout even to the sharp point of each prod.

So be safe—get the Knopp Voltage Tester. It is preferred by engineers, electricians, utilities, contractors, and maintenance men the nation over. Here is the voltage tester you can rely upon, backed by the 21 years' experience of the Electrical Facilities, Inc., technical electrical-equipment manufacturers of wide reputation. So don't kid yourself when testing. Play safe—know immediately if the circuit is open or closed and its true characteristics, by using the reliable Knopp Voltage Tester with its valuable safety features.

Order one from your dealer—see how it protects equipment, how it's easier to use in testing circuits, in locating faults—and you will KNOW that here is the quality BUY that costs less over its long years of safe use. Write for valuable, illustrated, free information sheets on the Knopp Voltage Tester.

ELECTRICAL FACILITIES INC.
4236 Holden Street Oakland 8, Calif.

RUGGED



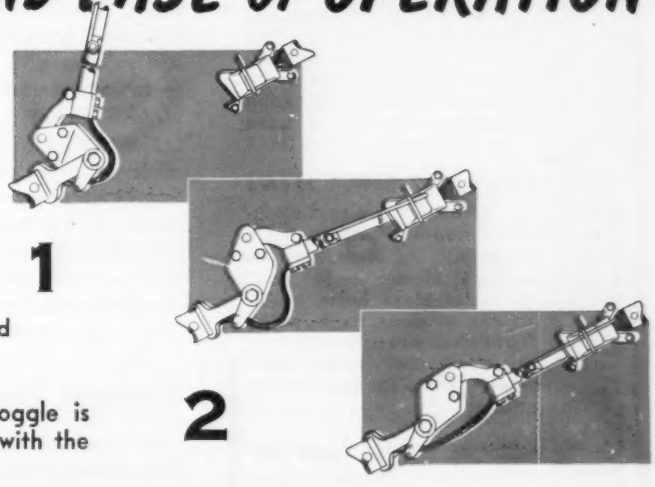
TYPE 57A

Side Break
Disconnect Switch

Model Illustrated
46KV-600 Amps

BUILT FOR SIMPLICITY AND EASE OF OPERATION

Here is simple mechanical linkage — ruggedly built—with a **shorter** leverage, providing a powerful thrust action in engagement—yet easily and simply operated, a feature of all Southern States equipment.



1. In the open position, full gap clearance is obtained, with the toggle collapsed.

2. In the initial contact, the toggle is still collapsed and full engagement has not yet been made.

3. Contact engagement is complete! The toggle is extended and the blade is in full contact with the jaw.

Application — Disconnecting, by-passing, sectionalizing.
7.5 KV to 69 KV, 400 Amps to 12.00 Amps.
Write for bulletin and complete information TODAY.

Southern States Equipment Corp.

HOME OFFICE AND FACTORY — HAMPTON, GEORGIA

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STOP SEASON CRACKING AND CORROSION

with HARPER SILICON BRONZE fastenings

Power companies throughout America are using Harper silicon bronze fastenings to help avoid power failures . . . and to end maintenance and replacement costs. These fastenings withstand extremes of temperatures . . . season cracking . . . atmospheric and other corrosion . . . in both overhead and underground construction . . . and now that modern treating has increased pole life so greatly, there are added savings in using fastenings that do not have to be replaced.

OVER 5000 STOCK ITEMS

. . . of nonferrous and stainless fastenings for immediate shipment . . . brass, bronze, copper, Monel metal and stainless steel bolts, nuts, screws, washers, rivets, nails. Many items are rare and hard to get . . . not stocked elsewhere. Write for the Harper catalog.

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Everlasting Fastenings
Chicago • New York

Some uses are manufacture of nameplates, panels, numbering or marking parts and tools, lettering, routing and milling small parts.

Master copy and engraved work are in sight of operator all the time. On this Cat. 252 pantograph machine, raising of the stylus arm automatically lifts cutter from the work. Range of area covered by cutter: largest is rectangle 7¼ x 2¼ in. with pantograph ratio 1.5:1, smallest is rectangle 2-¾ x 1-⅛ in. with ratio 4:1.

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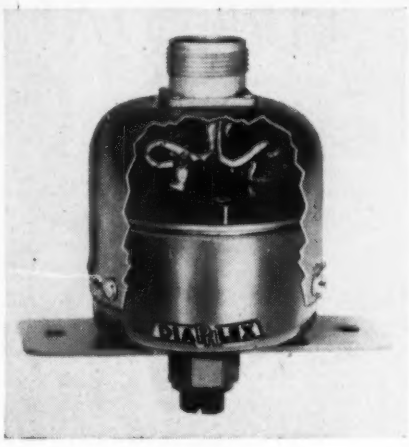


Pressure Switch

A NEW HYDTROL high pressure switch has been announced by Diaphlex Division of Cook Electric Co, Chicago 14, Ill. Tested design features are said to give the switch linear adjustment over an operating range from 50 to 5000 psi.

Construction makes possible a design of 9½ cu in. of displacement and a weight of 17 oz. Current rating is 10 amps. at 110 v a-c or 2 amp at 28 v d-c. Switch contacts are snap action spst, and are surrounded by an explosion resistant housing.

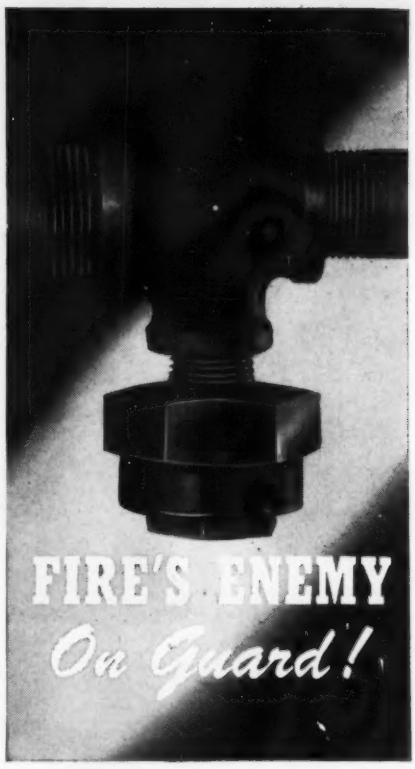
•

Thermal Timer

A MANUAL RESET thermal timer has been added to the line of electric heat control products of George Ulanet Co, 414 Market St, Newark 5, N. J. Applications are standby power plants and process control panels.

The timer is activated by a heater element which is wound on a bimetallic strip. When the heater element is energized the contacts open and will not close until the bakelite pushbutton is manually reset. The unit can be set for any desired time delay before breaking contact.

Standard model has normally closed rivetted contacts. Dimensions are 3½ in. long, 1¼ in. wide, and 1⅛ in. high overall. Rating is 1500 w, 115-230 v a-c. Timing range is 20 sec. to 3-min.



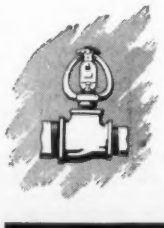
BLAW-KNOX FOG NOZZLES

non-clogging and always ready, are fire's worst enemy. Large passages in these spray heads assure a full free flow instantly when needed.

These nozzles produce the fog-plus spray—a cloud of fine water particles to smother fire, plus a driving spray that strikes through to the base of the fire, cooling and quenching.

Blaw-Knox Fog Nozzles are listed by Underwriters Laboratories, Inc., and are approved by Factory Mutual Laboratories.

Ask for Bulletin No. 2207



ALSO—

Blaw-Knox offers Standard Wet and Dry Pipe Systems and Thermostatically Controlled and Supervised Deluge Systems.

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SPRINKLER DIVISION
of Blaw-Knox Construction Company
829 Beaver Ave., N. S.,
Pittsburgh 12, Pa.
Offices in Principal Cities

NEWS ABOUT PEOPLE

Delaware Utility Creates New Executive Positions

Announcement has been made recently by the Delaware Power & Light Co, Wilmington, of the creation of two

H. H. PLANK

new positions. Harvey H. Plank, formerly vice-president and assistant general manager, has been named vice-president in charge of engineering and

L. R. LESLIE

operations, and Lloyd R. Leslie, formerly commercial sales manager, was appointed vice-president in charge of sales and public relations. At the same time, Frank P. Hyer was appointed supervisor of operations and Thomas W. McKenna, formerly supervisor of industrial gas sales, commercial sales manager.

Mr Plank became identified with the company as assistant to the general manager in 1943, being subsequently elected vice-president. Prior to his Wilmington connection, he was associated for many years with the United Gas Improvement Co in Philadelphia.

After spending several years in sales promotion work with the Philadelphia Electric Co in West Chester and Ardmore, Leslie joined Delaware Power in 1929 as sales manager. Having been in charge of commercial and appliance sales, he has been closely associated with the Chamber of Commerce in the promotion of Wilmington's business interests and has been engaged in many civic activities.

•

Electrical Men Honored By Several Universities

Several electrical men were among those distinguished individuals upon whom various colleges recently conferred honorary degrees or otherwise honored:

PHILIP SPORN, president of the American Gas & Electric Co, Columbia University, University Medal. The citation read in part: "A leader of unusual distinction in the field of electric utilities, whose alertness to current trends, and extraordinary and much-respected appraisals of power development, have been of inestimable value in fulfilling the needs of the public."

WALTER GEIST, president of the Allis-Chalmers Manufacturing Co, Michigan College of Mining and Technology, doctor of engineering.

LESTER A. MAGRAW, president of the Central Illinois Public Service Co, Worcester Polytechnic Institute, doctor of engineering.

WILLIAM C. WHITE, electronics engineer, Research Laboratory, General Electric Co, Columbia University, University Medal. The citation read in part: "Research engineer, whose inventive mind, concentrated upon the study of electronics, has over the past three decades contributed in many ways to the advancement of knowledge in that field."

► HARRY O. GRAY, formerly assistant treasurer of the Wilmington Trust Co, has been appointed vice-president of the Central Ohio Light & Power Co, Findlay.

Bose Made Chief Electrical Engineer, W. Bengal, India

Surendra N. Bose, who has been associated with the Tata Iron & Steel Co, Jamshedpur, India, for the past 21 years, the last 17 as chief electrical engineer, has severed this connection to join the Government of West Bengal as chief electrical engineer in the electricity development directorate.

Though a native of India, Mr Bose

S. N. BOSE

spent 17 years in the United States, 1910-1926, his connections including the General Electric Co, Pennsylvania Railroad Co, Cazenovia (N. Y.) Electric Co; with C. P. Perin and S. M. Marshall, consulting engineers and with the J. G. White Engineering Corp. His work included many phases of electrical engineering, including design, construction, tests, inspection and investigation.

Mr Bose is a fellow of the American Institute of Electrical Engineers and a member of the Association of Iron & Steel Engineers. He also holds membership in the Institution of Electrical Engineers (British), Institution of Mechanical Engineers (British) and the Institution of Engineers (India).

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► EVERETT L. PALMER, formerly assistant to the operating manager of the Pennsylvania Power & Light Co, Allentown, has been named assistant to the president. After completing the student training course, Mr Palmer entered the general commercial department of the company. Two years later he be-

came assistant to the general commercial manager and in 1940 was named manager of the rate and contract department.

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Bynum Named General Sales Manager of Carrier

Appointment of O. W. Bynum as general sales manager of Carrier Corp, Syracuse, has been announced. Since

O. W. BYNUM

1946 he has been manager of direct sales for Carrier. In his new assignment, Mr Bynum will continue these duties in addition to directing the overall line organization of the sales division under A. P. Shanklin, vice-president in charge of the sales division.

Mr Bynum joined the Carrier organization in 1930.

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▶ DR. E. F. W. ALEXANDERSON, consulting engineer for the General Electric Co, Schenectady, has been appointed by Governor Dewey of New York to the temporary state commission established by the 1948 legislature to plan for the observance of the Swedish Pioneer Centennial the week of June 28. The centennial commemorates the first Swedish immigration to the United States.

▶ A. G. RICKBORN, formerly plant superintendent of the Derby Gas & Electric Co, Derby, Conn., has been made superintendent of the new Rex Brown generating station of the Mississippi Power & Light Co.

▶ E. E. GAMET, superintendent of the municipal light and water plant at Canton, Mo, has been appointed city manager, Slater, Mo, effective June 1.

C. L. FEIGEL

C. L. Feigel Made Export Manager, Acme Electric

Charles L. Feigel, who has been connected with the Acme Electric Corp. Cuba, N. Y., for more than two years, as assistant to W. E. Wilson, vice-president in charge of sales, has been appointed export manager of the company, handling all foreign business.

Previous to entering the Armed Services, Mr Feigel was connected with the Buffalo Niagara Electric Corp in Olean, N. Y.

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▶ JAMES M. TODD, New Orleans consulting mechanical and electrical engineer, has been nominated as the next president of the American Society of Mechanical Engineers. Previously Mr Todd has held offices as manager and as vice-president of the ASME and has served on many of its important committees. He became a fellow of the society in 1944.

▶ L. M. KLAUBER, president of the San Diego Gas & Electric Co, has been elected a director of the California Chamber of Commerce. Past-president of the Pacific Coast Electrical Association and the Pacific Gas Association, Mr Klauber is also a director of Solar Aircraft Co and other companies.

▶ MAX E. BRETSCHNEIDER has been named director of employment of the Kansas City Power & Light Co, Kansas City, Mo. Mr. Bretschneider has been connected with the meter and laboratory department of the company for the past 16 years. He is a past-chairman of the Kansas City section of the American Institute of Electrical Engineers, a former member of the meter and service committee of the Edison Electric Institute and a member of the Missouri Valley Electric Association.

Westinghouse Makes Sales, Engineering Appointments

RALPH R. BRADY has been appointed manager of commercial engineering for the Westinghouse Lamp Division, Bloomfield, N. J., succeeding the late D. W. ATWATER.

Mr Brady joined Westinghouse at Bloomfield in 1929. He has held various executive positions in the commercial engineering department, which acts as a liaison between the lamp engineering, manufacturing and sales departments. Before joining Westinghouse, he was manager of the Bloomfield branch of the Electrical Testing Laboratories for 10 years.

Mr Brady is chairman of the Illuminating Engineering Society's committee on aviation lighting and is a member-elect of the board of managers, New York section, of the society. He is also a member of the American Society of Naval Engineers. During World War I he served overseas with the U. S. Army

R. R. BRADY

Signal Corps. As a civilian expert during World War II, he collaborated with the armed services on lamp and lighting problems.

Other appointments announced by Westinghouse recently include:

CHARLES H. WEAVER as industrial manager for the central district office in Pittsburgh. Mr Weaver was formerly marine and aviation sales manager at the East Pittsburgh Works.

BERNARD LESTER, assistant manager, headquarters, industrial sales department, has retired after 43 years of service. In addition to his recent position, Mr Lester has served since joining Westinghouse as commercial engineer, manager of the small motor division, assistant industrial sales manager, manager of the resale department and special representative. He has opened his own consultation service in the sale and

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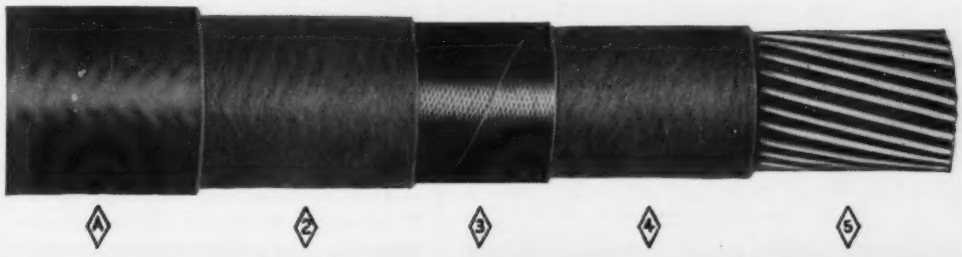

Rockbestos A.V.C. 600 Volt Power Cable—Code Type AVA—will operate continuously under temperatures up to 230° F. This cable and similar types ranging up to 5000 volts *pre-assure* trouble-free performance in hot locations . . . because of the unique 5-point Rockbestos A.V.C. construction.

You Need All 5 to Make Every Cable Purchase a DEPENDABLE DEAL

1
A tough, non-aging impregnated asbestos braid resistant to heat, flame, moisture, grease, oil and corrosive fumes.
2
An outer wall of impregnated felted asbestos—won't dry out, crack, flow, rot or burn—also protects the varnished cambric beneath from heat and oxidation.
3
Varnished cambric for high dielectric strength and added moisture resistance.
4
An inner wall of heat and flame resistant impregnated asbestos which acts as a baffle between the varnished cambric and hot conductors.
5
The conductor is perfectly and permanently centered in non-flowing heat resistant insulation which provides greater current carrying capacity.

. . . and you get All 5 with ROCKBESTOS A. V. C.

Here's the cable that's permanently insulated with impregnated felted asbestos: the insulation that won't lose resilience, bake brittle, crack, dry out, swell, flow, rot or burn—under even the toughest conditions.

This is the built-in Rockbestos A.V.C. protection that gives your installations years of trouble-free performance . . . that takes constant high temperatures up to 230° F. . . . and that withstands severe heating and cooling cycles, fumes, oil and grease—*without failure.*

Engineered for the most exacting installations, Rockbestos A.V.C. wires and cables are available in 600 to 5000 volt ratings—single or multi-conductor—with asbestos braid, lead sheath, armor or lead and armor. Also Type AVA Boiler Room Wire, Multi-Conductor Control Cables, Type AVB Switchboard Wires and Type AIA Wires and Cables.

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ROCKBESTOS A.V.C. — *The Wire with Permanent Insulation*

STATES TESTING EQUIPMENT

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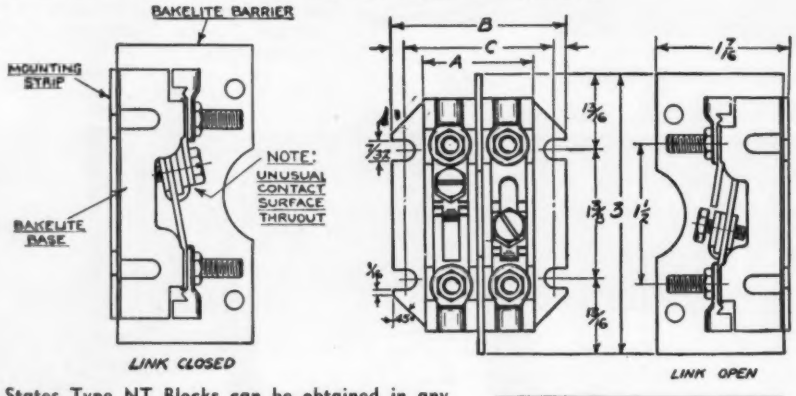
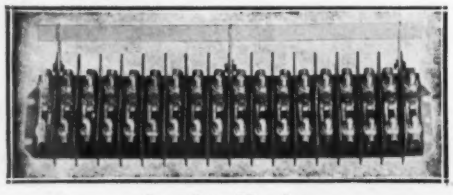
TYPE NT SLIDING LINK TERMINAL BLOCKS

Are Test Blocks Too

A good way to terminate wires, and an easy way to check circuits without disturbing permanent wiring.



States Type NT Blocks can be obtained in any number of poles to 60, front or back connected, with or without cover, with or without marking or coding strip.



from 1 to 60 poles

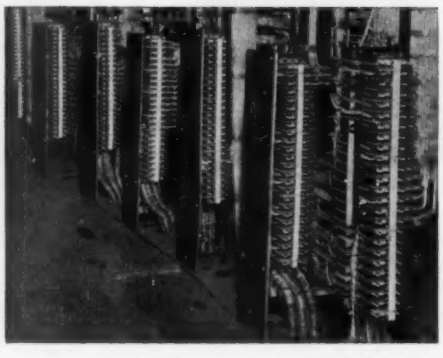
CHECK the FACTS

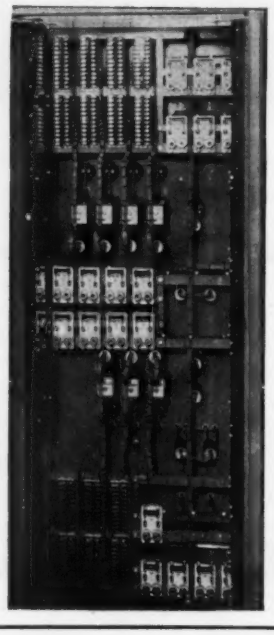
Any number of poles through 60.

Simplicity of coding and testing crowded circuits.

Operated with screw driver or a hex wrench. No parts to remove.

Excellent for Relay Circuits, Signal, and Intercommunication circuits, fire alarm circuits, etc.





Here is an excellent method for terminating incoming cables and panel connections. Type NT Blocks may be placed in any position they seem to best fit. They fit into out of the way places when you are cramped for space. (See cut to the right. For complete information see Cat. 1 Sec. 6.

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distribution of machinery and equipment for managers of medium-sized and small industrial equipment builders and suppliers. He is a member of AIEE, ASME and ASEE.

J. D. MITCHELL, formerly Army radar officer, has been made district engineer of Westinghouse Lamp Division's southeastern district. Mr Mitchell joined Westinghouse commercial engineering department in 1939 at its Bloomfield Works. After discharge from military service he rejoined Westinghouse in 1946 and has been specializing in fluorescent lamps. Mr Mitchell is a member of AIEE and IES.

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▶ J. C. ARMOR has been promoted from head of the power transformer design section to consulting engineer at the Pittsburgh Works of Allis-Chalmers Mfg Co. Long associated with radio and transformer design and development, Mr Armor entered the employ of the Pittsburgh Transformer Co in 1920 as design engineer. In 1927 the company was acquired by Allis-Chalmers. Mr Armor holds a number of basic patents. He is a fellow of the American Institute of Electrical Engineers.

▶ LUKE E. SAWYER, formerly vice-president and general manager of the Babcock & Wilcox Tube Co, New York, has been elected executive vice-president and a director. Mr Sawyer takes over the major management responsibilities in the company following the death on May 6 of Peter D. White, president of the company. Before becoming vice-president and general manager Mr. Sawyer was general superintendent. He has been with the organization 37 years. ALFRED IDDLES, president of the Babcock & Wilcox Co, the parent organization, has also been elected president of the Tube Company. E. A. Livingstone, who has been general sales manager since 1939, has been elected vice-president in charge of sales. He has been with the company for 18 years.

OBITUARY

▶ HENRY O. PALMER, a director of the New York State Electric & Gas Corp, Ithaca, N. Y., and formerly president of the Empire State Gas & Electric Co, Geneva, N. Y., died suddenly on May 31. He was 63 years old. Mr Palmer was born in Geneva and received his education at Hobart College and Cornell University. He entered business with his father, who had founded and was president of the Empire State company. Mr Palmer took over the presi-

dency of the company when his father died in 1931. When the company became part of the New York State Electric & Gas Corp, he was made a director of the latter company. In 1939 he was appointed treasurer of Hobart College, a position he held until 1943. During World War II he was with the Army Air Forces in New York City in the renegotiation of contracts.

▶M. C. GILMAN, commercial manager of the Winnipeg Electric Co, died on May 14 after a long illness. Earlier in his career he was connected with the Toronto Electric Light Co and the Montreal Light, Heat & Power Consolidated. He went to the Winnipeg utility in 1921. Mr Gilman served as president of the Canadian Electrical Association in 1938-39.

▶A. B. GIBSON, founder and president of the Gibson Electric Co, Pittsburgh, Pa., died on June 5 at the age of 55. He was a founder and past-president of the Western Pennsylvania Industrial Conference. Born in Fort Jackson, N. Y., Mr Gibson was graduated from the Clarkson College of Technology. Later he was employed by the Westinghouse Electric Corp in the company's transportation division. In 1933 he founded the Gibson Electric Co.

▶R. F. ALLEN, safety engineer, Illinois Commerce Commission, died on June 2 at the age of 66. Mr Allen became associated as assistant safety engineer for the Illinois Commerce Commission in 1938 and was appointed safety engineer in 1946.

▶GEORGE H. SANDER, a retired district manager for the Public Service Co of New Hampshire, Manchester, died on June 4. Mr Sander went to Manchester 35 years ago as commercial manager of the Manchester Light & Power Co and continued with the Public Service Co of New Hampshire until his retirement in 1945.

▶GEORGE D. ROGERS, vice-president of the board of directors of the West Kentucky Rural Electric Cooperative Corp, Mayfield, Ky., died at his home in that city on June 1. He was 50 years old.

▶LIONEL G. MCCRAY, engineer with the Bureau of Reclamation at Phoenix, Ariz., died on May 26 of a heart attack. He was 39 years old.

▶PERCY H. NEVILLE, vice-president, treasurer and director of the Leece-Neville Co, Cleveland, died on May 12 at his home in Henrietta, Tex. He was 62 years old.

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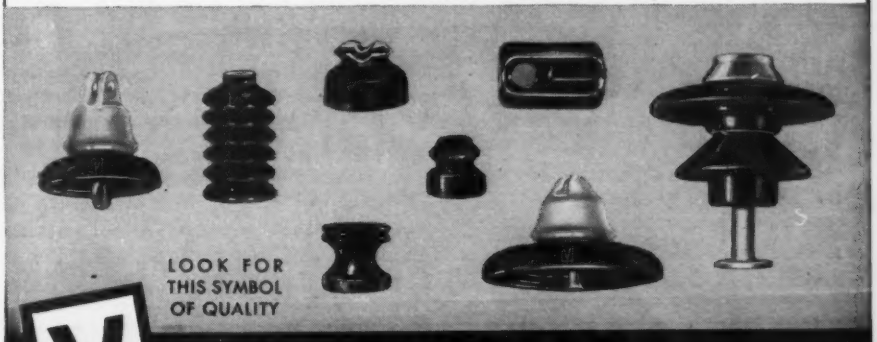

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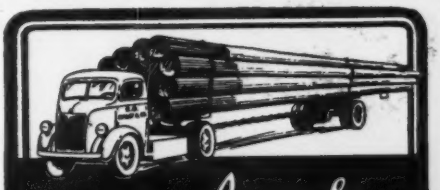

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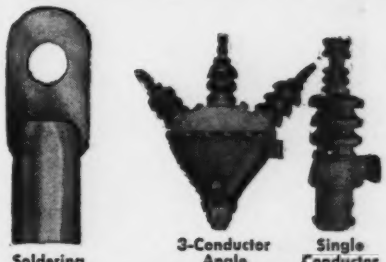

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MANUFACTURERS and MARKETS

Alcan Will Make Preliminary Survey of British Columbia Location for Plant

The Aluminum Co of Canada will make a $100,000 preliminary engineering survey of the Bute Inlet area on the British Columbia coast some 180 miles north of Vancouver to determine power resources and site possibilities for establishment of a plant comparable to its $300,000,000 plant at Arvida, in Quebec.

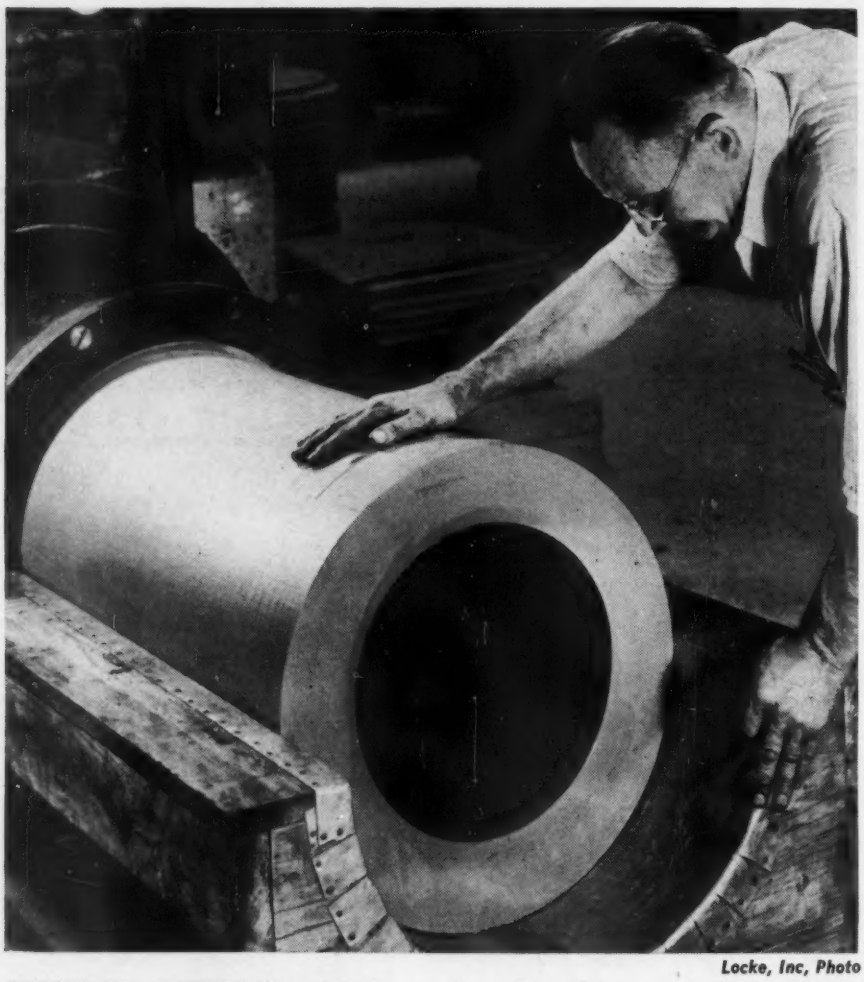
The Bute Inlet area, involving the undeveloped Chilko-Taseko lakes power system 40 miles back in the mountains at the head of the inlet, is one of three being considered by the company. According to a survey by government water engineers, the site could produce about 1,083,000 hp.

Inspection of the area was made at the end of May by R. E. Powell, Alcan president, in company with Lands and Forests Minister E. T. Kenney. Powell, on his return from the Bute Inlet area, said the company would undertake the preliminary survey before going ahead with a full engineering survey which would cost about $1,000.000, and take about two years.

It is hoped the preliminary survey will start in about a month. Inspections will also be made of the two other potential sites, at Dean Channel, 350 miles north of Vancouver, and Gardner Channel, 450 miles north, near Prince Rupert. The power site of the Dean Channel area is the Eutsuk-Kimsquit Lakes system, capable of producing 910,000 hp, while Tahtsa-Kemano system, at the head of Gardner Channel, is capable of supplying about 845,000 hp.

The main reason for locating at the Bute Inlet site would be the abundant hydroelectric power there, but Powell commented:

"We generally spend about $2 on plant and town development for every $1 on hydroelectric development. At present there isn't even a clear place for a construction camp or a workers' town. It is a great distance from any established center of population, and we cannot afford to erect monuments."



Locke, Inc, Photo

SUCCESSFUL EXTRUSION of the largest pieces of porcelain ever extruded from a pug mill was reported last month by Locke, Inc, Baltimore. The porcelain cylinders, intended for oil-filled bushings, were 28 in. long, 22 in. outside diam, and 2½ in. wall thickness. Ordinarily pieces of this size are cast. By pugging them manufacturing time was halved and the percentage of rejects greatly reduced

Hotpoint Reports Upsurge In Water Heater Sales

Hotpoint electric water heater sales for the first seven months of 1948 will equal total company sales for 1947, Dwight R. Anneaux, manager of the water heater department, predicted at a recent meeting of company marketing officials and distributors.

Mr. Anneaux reported that a heavy buying upsurge began in April, with current water heater sales maintaining a consistent increase. Although water heater sales normally fall off during July, sales are expected to hold up well throughout the year, he said.

The large scale home building program was cited as a significant factor in stepping up water heater sales. In addition, many utilities are returning to promotion of the electric water heater as an off-peak load builder.

Summarizing the factors that have established the electric water heater as a leader "among the most wanted appliances", Mr. Anneaux told the marketing officials that there is a definite trend

CORRECT
in every detail!
. . . this LIONEL
steam turbine type locomotive is recommended for model railroaders from 8 to 80 years old. Natvar Saturated Fiberglas Sleeving and Natvar Saturated Rayon Sleeving are used to give internal wiring permanent protection from shorts.
Natvar

Natvar Products

- Varnished cambric—straight cut and bias
- Varnished cable tape
- Varnished canvas
- Varnished duck
- Varnished silk
- Varnished special rayon
- Varnished Fiberglas cloth
- Silicone coated Fiberglas
- Varnished papers
- Varnished tubings and sleevings
- Varnished identification markers
- Lacquered tubings and sleevings
- Extruded vinyl tubing
- Extruded vinyl identification markers

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Trains and accessories built by The Lionel Corporation are a source of satisfaction not only because they *look* authentic, but because they actually operate for years, absorbing the shock of collisions, derailments, wrecks, and still surviving to run on schedule for the next generation—that is, if the youngsters can get the controls away from their parents.

Natvar Saturated Fiberglas and Natvar Saturated Rayon Sleevings are used on internal circuits because they give ample and uniform protection, and because they are smooth and easy to apply.

If your requirements call for insulating materials with good physical and electrical performance characteristics, it will pay you to use Natvar. Get in touch with your Natvar distributor, or with us direct.

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ALL the strength and durability inherent in steel are combined—with definite economies—in *Crapo* Galvanized Steel Strand. Heavy, ductile, tightly-bonded zinc coatings, applied by the famous *Crapo* Galvanizing Process, provide lasting protection against corrosion.

Ask the distributor of *Crapo* Galvanized Products near you or write direct for further information!

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LEAD & ALUMINUM PAINT
Simplify Maintenance
Give Maximum Protection
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HACKENSACK, N. J.

toward complete electrification of the modern home. The pre-war sales ratio of electrical water heaters to gas types was one to three, while the current ratio is one to one and one-half, he stated.

•

Orangeburg Workers Get Rucker Plan Bonus

A bonus of 20 cents an hour over and above his regular pay has just been paid each hourly employee of the Orangeburg Manufacturing Co, Orangeburg, N. Y. And there will be more of these bonuses.

The bonuses are a feature of the Rucker Share of Production Plan adopted by the company as of April 26 for a trial period of six months. The plan guarantees the workers total earnings of 35.59% of the production values they help to create. These values are arrived at by deducting from the company's sales values the cost of materials and services purchased from others to manufacture the product.

Payments under the plan are made to the workers every four weeks. Those just received covered the period from April 26 to May 23. Before the plan was adopted, Local 1255. International Brotherhood of Electrical Workers, AFL, voted its approval. The workers belong to this union.

•

Manufacturers Make New Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

Chicago Electric Manufacturing Co has appointed Norman B. Elrod southwestern representative to direct the company's activities in the following states on both their Handy-Hot and Sterling appliances and fans: Texas, Oklahoma, Kansas, Colorado, Nebraska and the western half of Missouri. His office will be in Kansas City, Mo. Mr Elrod was formerly connected with Bussmann Manufacturing Co and Emerson Electric Co.

Camfield Manufacturing Co. Grand Haven, Mich., has appointed Fred W. Stegeman Detroit district manager with headquarters at 1414 Dime Bldg. His territory includes Michigan, Ohio, West Virginia and part of Pennsylvania and Kentucky.

Ilg Electric Ventilating Co, Chicago, has made Carl E. Brock, Jr, branch manager at the St. Louis office. H. L. Branigin, formerly branch manager at St. Louis, is retiring after a period of 25 years service.

Electromaster, Inc, Mount Clemens, Mich., has appointed Hollander & Co, 3900 West Pine Blvd, St. Louis, as distributors for 33 counties in Missouri, and 38 southwestern Illinois counties.

RECENT RATE CHANGES

FRANKLIN POWER & LIGHT CO, Franklin, Tenn., has been authorized by the state Railroad and Public Utilities Commission to reduce its electric rates to the level of 32 municipally owned distribution systems served by TVA. The new rates begin at 2.5 cents per kwhr for the first 75 kwhr of domestic service and go down to 0.4 cents per kwhr.

VILLAGE OF GREENE, N. Y., which operates a municipal electric plant, has been authorized by the state Public Service Commission to put into effect revised rates for electricity, which will result in a saving of approximately $5,000 per annum to consumers. The reduction will become effective July 1. The present minimum charge of 90 cents per month with an allowance of 12 kwhr in the minimum remains unchanged. The next 18 kwhr, 13 to 30 inclusive will be reduced by one-half cent, from 5½ to 5 cents. The next block of 5 kwhr will be reduced from 5.5 cents to 4 cents per kwhr. The rate of 4 cents per kwhr for use between 36 and 60 kwhr will remain unchanged, but the next block of 15 kwhr, that is, 61 to 75, will be at the rate of 3 cents per kwhr against the present rate of 4 cents. The next 45 kwhr, the block between 76 and 120 kwhr, will be the same as at present, 3 cents per kwhr. For use between 121 and 150 kwhr the rate is reduced from the present 3 to 2 cents per kwhr and all use of over 150 kwhr will be reduced from 2.5 to 2 cents.

WAYNESVILLE (N. C.) Municipal Electric Dept will reduce its commercial power rate by about 20%, effective July 1.

GEORGIA POWER CO hearing before the state Public Service Commission on the utility's request to raise electric rates 10% for residential, commercial and industrial customers (EW May 8, p 154) has been postponed from June 21 to July 12 at the request of the Georgia Cotton Manufacturers' Association.

SASKATCHEWAN POWER COMMISSION, Regina, Canada, new rate schedule (EW Apr. 24, p 133) became effective June 1. The reduction will affect the greater number of urban and rural centers served by the commission, most getting the maximum reduction, one cent per kwhr, although in some cases the half-cent cut will apply on the first block of energy for residential lighting, commercial lighting, residental combination and commercial power service. The reduction has been made possible despite increased cost of fuel, material and labor, through the consolidation of various power systems in the province into one unit, Resources Minister J. L. Phelps stated.

•

Television Has Future

Within five years, television will develop into a $600,000,000 receiver sales business at retail value and will serve more than 40,000,000 people in the 140 principal U. S. markets. This prediction was made by Arthur A. Brandt, general sales manager of the General Electric Co's Electronics Department.